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Hands Off the Chemical Tariff!

IF RESEARCH is the foundation of chemical progress, what then underlies research? Primarily it is confidence in the future—courage to spend money today in the confident expectation that more will be returned tomorrow. Hence it is fundamental that anything which threatens the long-time operations of an industry strikes a vital blow at its research program. This point was made with telling effect by a number of chemical representatives who appeared before the Tariff Commission Committee for Reciprocity Information. Warren N. Watson, secretary of the Manufacturing Chemists Association, stated unequivocally that drastic reduction in the import duties on certain chemicals "would jeopardize present and future research programs as well as the development of new products as the result of research." Thus tariff protection, for the first time to our knowledge, is put on the basis of a vital need in an industry that must constantly invest in the future in order to assure the development of new and improved products and processes essential for its continued progress.

Proverbially, periods of tariff revision are disturbing times for business. This is one of the reasons that in the depths of the depression in 1932-33, the present Administration decided to do the job on a piece-meal basis. Another was the sincere and honest desire of Secretary Hull to stimulate trade by breaking down economic barriers between countries through his negotiations for reciprocal trade agreements. Quite logically, he started with the smaller and less important industrial countries and, as the newness wore off and the technique improved, he moved gradually toward the most difficult of all, Great Britain and Canada.

Despite great friendship among English speaking people, there has always been intense rivalry in trade. As a result more than one Administration in the past has come to grief over Canadian reciprocity. And today there is the added complication that any concessions extended to the United Kingdom will apply equally to Japan—from which a number of divisions of chemical industry are already experiencing vigorous competition. Almost as important is the indirect competition resulting from the increased imports of textile, leather, ceramic and paper products which have been made with foreign chemicals.

Lately we have seen the interesting spectacle of organized labor seeking tariff protection for many of the products of American industry. As yet there has been little or no formal representation on the part of technical men interested in the future of the chemical industry, but there might well be, especially if the effects of the present disturbance spread to the research laboratories. Drastically curtailing or abandoning research programs in the face of business uncertainties would certainly be a most cowardly retreat. Instead, let us marshall our facts and forces and see that they are effectively presented to the Congressmen and Senators of our own districts. Let us give specific information about our products and plants, and the effect of increased foreign competition on payrolls and employment. Armed with definite information of this sort, our Congressmen can accomplish a great deal with the State Department and the other administrative agencies involved.

We need not assume that in presenting information of specific importance either to a company or a community, we necessarily repudiate the idea of a fair and equitable basis for foreign trade. But in times like these, it would be well to remind Official Washington that it should be concerned with the present and future of a key industry—as essential for national welfare in times of peace as for national defense in a military emergency.

From an EDITORIAL VIEWPOINT

WITH TVA ON THE CARPET

THOSE who wanted a full airing of all the differences of policy and opinion within the TVA organization are now to have their way. In the end we may expect either a vindication or a condemnation of one of the two clashing viewpoints. Charges and counter-charges will get into lurid headlines, and perhaps eventually into a political report to be the basis of corrective legislation. But what happens in the meantime? The regular work of the staff is certain to be interrupted and some of it neglected as the whole organization is put on the defensive. Projects that depend upon legislative enactment, as for example, the Gilbertville Dam, will have to be postponed. Fortunately, the chemical engineering program has not been called into serious question and is so organized that it can go ahead toward its objectives even if the battle rages all around it. Still, one can only wonder whether anything constructive and worthwhile can possibly come from this expensive inquisition by the Congress.

KEEP POLITICS OUT!

THAT PROVISION in the Farm Relief Act which made $4,000,000 available for chemurgical research seems to have opened the gate for a virtual flood of political proposals—local, regional and national. Representatives from all parts of the country are urging the advantages which they can offer for the four regional laboratories shortly to be established by the Department of Agriculture. Other agencies are beginning to come forward with their own proposals as to how all this money should be spent. The law merely provides for the investigation of those agricultural products for which adequate market is not now available. Obviously, non-food uses will generally be sought.

This is the greatest chemurgic experiment ever authorized. It affords the prospect of the greatest waste or the greatest opportunity for real service that has been placed before the agricultural chemical investigator at any time. Solution of the many policy and technical questions that will be met will not be easy. But their solution along sane sound lines will be of great value to chemical process industries as well as to agriculture.

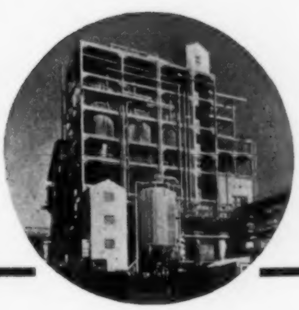
Fundamental studies which seem least promising of immediate result may, in the long run, prove the most valuable work which can be undertaken. Only the Government can afford many of these studies. Only the Government's broad investigations will be persuasive in encouraging the right kind of future development in many small enterprises. Take fats and oils as one example. If we only knew just what fats and oils were available, had complete knowledge of their chemical and physical properties, understood how these properties are related to their performance in service, many industrial advances could be made. Perhaps we might even make America self-sufficient in fats and oils, provide for the growing of drying oils in ample quantity, and secure abundant supplies of short-chain fatty acids for the soap maker. Like opportunity lies in other fundamental studies.

Political considerations will press on the Department of Agriculture from every side. Let us hope that they can be resisted adequately. In the long run it will be the best politics to get some results of practical and industrial value, not this year and next alone, but for a very long time to come. The Department never had a greater opportunity to exhibit wise research planning.

"THEY SHALL NOT PASS!"

"COCKEYED LEGISLATION" is the description given to Representative W. D. McFarlane's compulsory licensing patent bill (H. R. 9259) by one of the many irate business men, chemists, engineers and inventors who appeared at the Committee hearing late last month. Some witnesses savagely attacked the measure as an abortive attempt to abolish the entire patent system. Others, recognizing that it represents one unfortunate type of thinking that is all too prevalent in the Administration, sought to introduce amendments or otherwise redraft the proposed measure to eliminate its most dangerous features.

The whole matter brings up an important question of policy and procedure that is bothering many of us. Is it better to strike out boldly and determinedly beat down each such silly and dangerous proposal? Or should we attempt to educate and work with our representatives in the hopes of shaping their legislation along saner and more constructive lines? Natural inclinations have counselled the latter course, but the discouraging results of recent experiences are fast converting many of us to strong-armed tactics. Look out!



HUMANIZING THE ANNUAL REPORT

NOT CONTENT this year with having exceeded its own fine record for the most interesting, readable and informative of annual reports to its stockholders, Monsanto has just mailed a special "humanized" edition to all of its employees. Within its sixteen pages, President Queeny engages in a frank and informal talk with his fellow workers about all of their common problems. He explains his and their relations to the company's 9,000 stockholders and to their "real bosses"—the men who buy what they produce. He analyzes the balance sheet in understandable terms of "what we have" and "what we owe." He talks frankly about the seriousness of the present depression but presents a more cheerful and hopeful outlook for the future.

This is the first time that Monsanto has attempted such an annual report to its employees, but it has done the job exceedingly well. President Lewis H. Brown of Johns-Manville has also presented a somewhat similar report to the members of the J-M organization. One cannot read these reports without gaining a more intimate and sympathetic understanding of the two companies. For that reason they serve the double purpose of promoting better public as well as human and industrial relations.

POINTING THE WAY

CHEMICAL ENGINEERS of our acquaintance have often remarked that their college courses failed to include many subjects that might have proved helpful to them in meeting the economic social and political problems of today. They repeat the old cry that engineers need more non-technical training. Yet, to date, little has been done to change that situation—perhaps because there has not been any single and effective agency for making that cry heard in the proper places.

Fortunately the engineering profession is now beginning to find its voice in this matter. The Engineers' Council for Professional Development, in its fifth annual report, speaks with authority on this very problem of non-technical training. It makes the following pertinent observation:

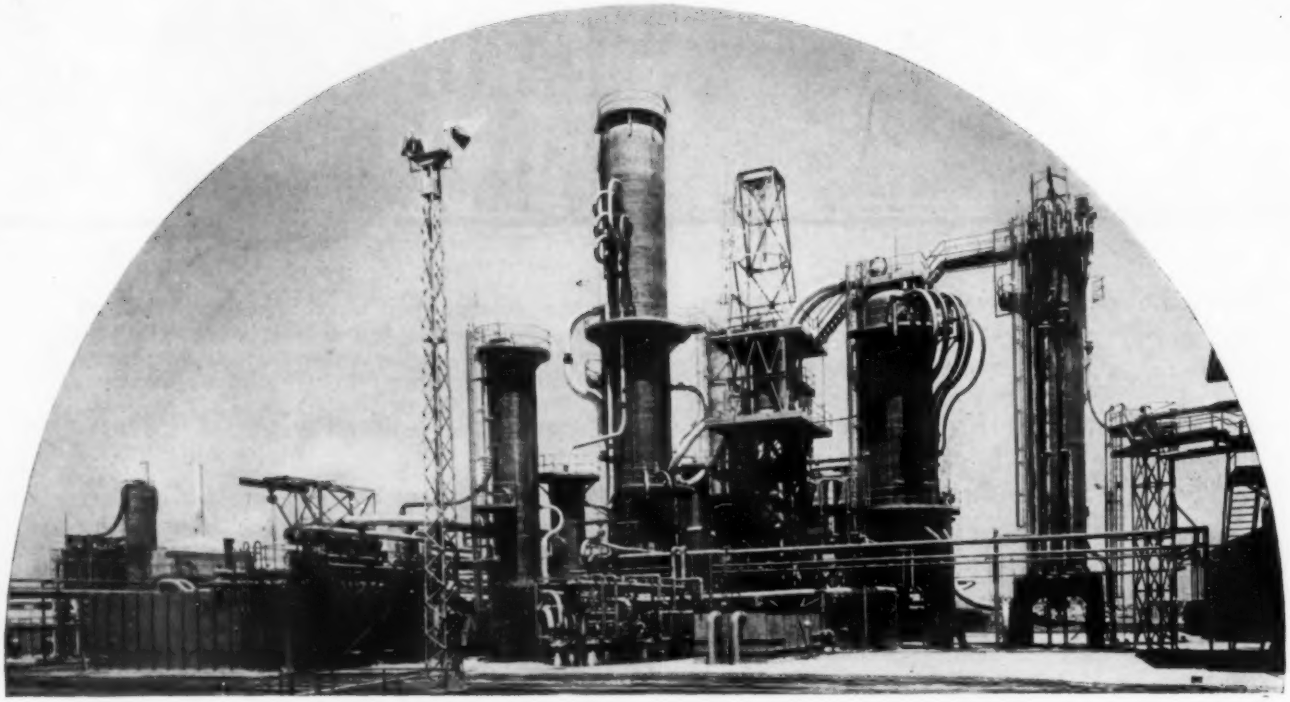
> Today it is the boy who likes machines who inclines to the engineering school; curricula and teachers are saturated with the technical and efforts to liberalize are often without clear objectives or effective methods; early after graduation years tend to concentration on the job with little of idealism; tests for professional recognition are often assumed to fathom technical competency with little concern for "liberal" ideals or interests; and among older engineers there is apt to be indifference when programs shift from the technical topics.

Such conditions and aptitudes are out of place in the engineering training of the future. Our educators must attack these problems and provide remedies as rapidly as possible. Fundamental changes may have to be made in the content of some undergraduate courses. In others it may be necessary to provide an extra year of graduate training in order to give proper balance of technical and cultural material. E.C.P.D. has rendered a service in bringing this problem forward for discussion by the engineering profession—in pointing the way toward a worthwhile objective. It remains for the constituent societies to organize their programs and make them effective in the different branches of engineering education.

LOOKING BACK O'ER THE YEARS

ANNIVERSARIES roll around surprisingly soon and in the world's mad rush are often overlooked and forgotten. Yet there is so much of value and inspiration in history that we can well afford an occasional look back through the years. For example, it was just thirty years ago in June that the brave little group of pioneers met in Philadelphia to organize the American Institute of Chemical Engineers. But most of the growth of our profession has occurred in the 20 years since the end of the World War—another anniversary to celebrate this year.

In Wilmington, Del., 1913 was a momentous year for it saw the birth of the Hercules and Atlas companies. Diamond Alkali and American Agricultural Chemical are also celebrating their silver anniversaries in 1938. Cyanamid's thirty years, ended last December, brings a handsome volume to remind us of the changes that have taken place in that industry since the struggling days of its first plant at Niagara Falls, Ont. And we are all mere youngsters compared with Mutual Chemical's 85 years or Innis Speiden's 122 years. No, we are not going back to John Winthrop again, but being 36 years old ourselves "coming September," *Chem. & Met.* does want to extend birthday greetings to both its elders and its juniors.



A 12,000 bbl. per day Dubbs crude oil topping and selective cracking unit

Changing Processes of Petroleum Refining

By GEORGE F. FITZGERALD
CHEMICAL ENGINEER
OLEAN, N. Y.

Editor's Note—Since receiving his degree in chemical engineering from the University of Notre Dame in 1925, the author has been continuously employed by one of the major oil companies in the East. He progressed through routine control work to experimental development and about four years ago was put in charge of pilot-plant operations where he has had occasion to study the chemical and chemical engineering aspects of many of the various oil refining processes discussed in this article.

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CHARACTERISTIC of current changes in the petroleum refining industry is the steady departure from established processes. Refining methods long revered because of their antiquity are failing to produce the results required by today's markets. This is especially true in gasoline processing. Modern internal combustion engines require a higher quality motor fuel than ever before available. Every practical means must be found to improve these products in order that automotive design may not be hampered. A few years ago 70-octane fuel was regarded as a great achievement; today 100-octane gasoline is already on the market.

In the search for quality, every refining process has been subjected to thorough investigation for it is realized now that serious losses in octane value have accompanied many refinery operations. One of the worst offenders appears to be the time-honored "doctor" treatment for removing odorous sulphur compounds from gasoline. As is well known, the sweetening effect of doctor solution (sodium plumbite—caustic soda) is obtained by the primary reaction with mercaptans, resulting in the precipitation of lead sulphide.

In the batch treatment of so-called sour gasoline with doctor solution, free sulphur is added after sufficient time has elapsed for the mercaptans to react with the sodium plumbite. This dosage of sulphur is usually determined empirically by that change in the appearance of the batch which is usually known as the "break." The treated gasoline changes in color from reddish to white after the addition of sufficient sulphur. Unfortunately the break is not instantaneous and sulphur is usually added in excess, thus making the gasoline corrosive.

The continuous system of doctor treatment reduces losses due to weathering, but presents a difficult problem of control, especially where several grades of distillate are being treated. Success depends upon the judgment of the operator; hence the quality of finished product often varies widely from one shift to the next.

While the refiner has been combating these operating difficulties, the research man has discovered inherent defects in the older treating process. For example, Schulze and Buell (2) reported in 1937 that the primary reaction in the doctor treating process is accompanied by side reactions which result in the formation of polysulphides. These side products were considered unimportant until it was learned that they produce a pronounced knocking effect. This knock promotion may result in the loss of one to three octane numbers, with an additional loss due to lessening of susceptibility to corrective treatment with tetraethyl lead.

The formation of polysulphides from mercaptans is promoted by several factors which are present in almost all variations of the doctor treatment. Notable is the fact that such oxidation will occur in the presence of caustic soda and free sulphur alone. Since the loss in octane value of doctor treated gasoline appears to be due mainly to these polysulphides, the greatest efforts are being made to develop methods of treating which will achieve sweetening plus gum and color stability by complete conversion of mercaptans to the relatively unobjectionable disulphides.

New Copper and Lead Processes

Among the newer methods copper sweetening (3) is attaining prominence. It is claimed for these processes that polysulphides are not formed because all the mercaptans are oxidized completely to disulphides. The copper chloride treating agent being acidic does not favor polysulphide formation which requires an alkaline medium. By the elimination of side-reactions copper sweetened gasoline is produced with greater color and gum stability. Lead susceptibility is improved and smaller amounts of inhibitors are required.

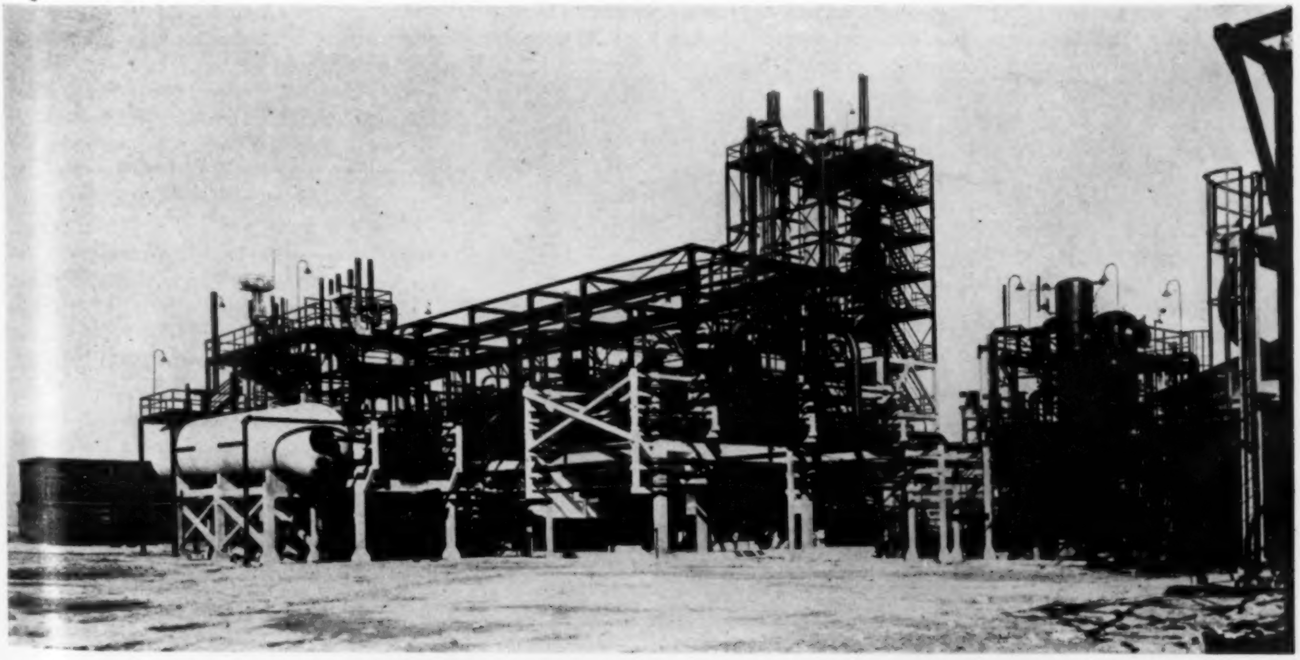
Similar results are obtained by the lead sulphide method (4). The treating agent is a suspension of finely divided lead sulphide in strong caustic soda. Gasoline entrains a certain amount of air when pumped and this "dissolved oxygen" is the only chemical actually consumed in the process.

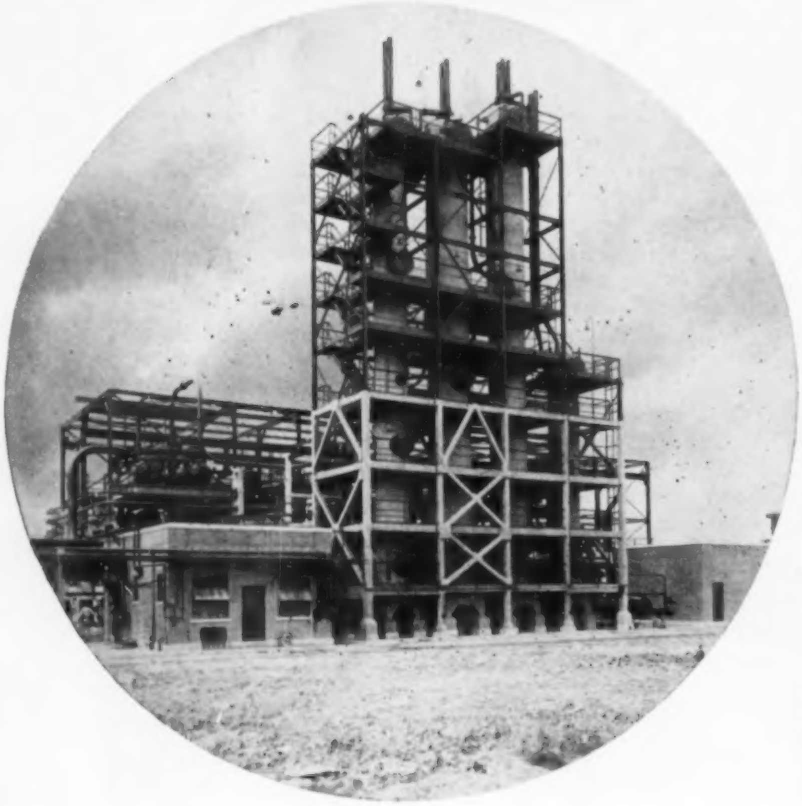
Since the treating agent, PbS, is not consumed the reaction is essentially catalytic and chemical costs are small. There is one feature, however, which is apt to be a distinct disadvantage. The amount of dissolved oxygen may not be sufficient in certain distillates. Auxiliary air must be added in such cases under exact control. Excess air will cause formation of excess sodium plumbite which in turn would promote side reactions resulting in polysulphides, as previously mentioned. As a preventive, controlled amounts of aqueous sodium sulphide are added to precipitate the plumbite as lead sulphide.

In the end the perplexed refiner is apt to feel that lead sulphide treating, with its requisite exact balance of several reactions, would cause him almost as many headaches as doctor treating. As with copper sweetening, no free sulphur is used and gum and color stability of the finished product are equal to the original values.

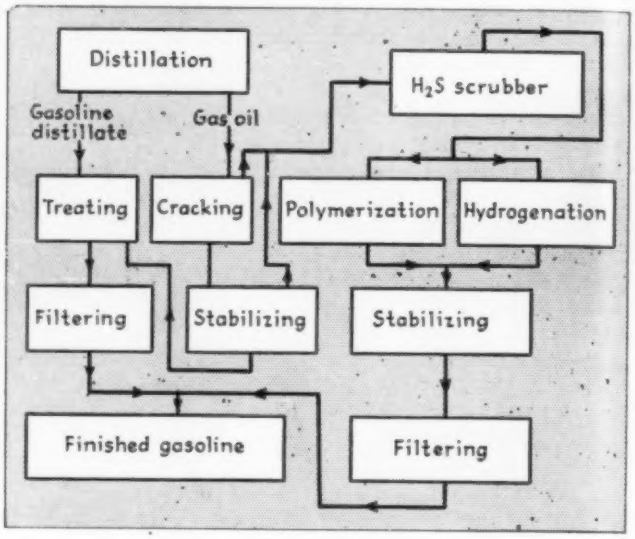
The more drastic sulphuric-acid treatment has had almost as many proposed modifications as the original doctor treatment. The conventional batch treatment in agitators is subject to the usual drawbacks of all such operations. The reaction cannot be closely controlled and over-or-under-treatment is usually the rule. Losses by polymerization to tars or resins are usually large. Other important losses are involved in handling and by

Side view of the world's largest catalytic polymerization plant showing, from left to right: the fans and end of forced draft cooling tower; stabilizer feed surge tank in front of reflux accumulators; heat exchangers, condensers, and coolers above and behind the reactivation gas compressors; process towers (in the background) and scrubbing towers for gas used in catalyst reactivation





At left: Control buildings, gas absorber, depropanizer, debutanizer and rerun tower in new plant employing U. O. P. catalytic polymerization process. Below: Outline of general sequence of various gasoline processes



occlusion in the sludge. Octane degradation is severe and gum and color stability are poor. Those factors causing loss of quality are largely functions of contact time and temperature; hence the newer methods employ orifice contactors and centrifugal separators or gravity settling. Temperature control is obtained by refrigeration or cooling water in some cases.

Sulphuric Acid Still the Standby

Distillates of high sulphur content have for some years been successfully refined by cold acid treatment and recent developments (5) indicate that the use of sulphuric acid as a treating agent is by no means approaching an end. The technique has been so improved that intimate dispersion, exact control of contact time and immediate separation of both phases are readily possible. The optimum temperatures fall between 20 deg. and 60 deg. F. and must be established for each type of treatment. In practice, direct expansion ammonia is applied to refrigerator heads on the contactors to absorb heat as the reaction progresses. By proper temperature control, desulphuring is attained with minimum treating and polymerization losses. A very striking saving of one to three octane numbers is possible with controlled treating temperatures, as compared with uncontrolled conditions. Centrifugal separation is used where prolonged contact with acid and acid sludge is injurious to the distillate. In other cases gravity settling is satisfactory.

After desulphuring, the octane value of commercial gasoline may now be stepped up by blending with high-octane stocks obtained by sulphur dioxide extraction (6). Distillates from a wide variety of crudes have yielded concentrated extracts of unsaturated and aromatic hydrocarbons of 80 to 90 octane value which may be blended directly or further fractionated to yield 100 octane material. The latter has a wide field as a lacquer solvent because of its characteristic high solvency for most varnish gums and resins.

Low octane gasoline may be reformed concurrently with gas oil cracking operations. By substituting this gasoline for part of the regular charge and adjusting temperature and pressures, a product is obtained almost equal in anti-knock quality to the former cracked distillate. The quantity that can be reformed will depend entirely on local conditions of total capacity, settlings required for gas oil cracking, and the volume of low grade gasoline available. Naturally the amount of reforming is governed by the temperature and pressure required for satisfactory oil cracking. Hence it is felt that with an adequate supply of low octane gasoline to be reformed, a separate unit would be more efficient. However, if there is excess cracking capacity and a limited amount of naphtha available, the concurrent method is advisable. The finished gasoline may be of slightly lower octane number but that loss is out-weighed by the advantage of improving the original low grade material.

The reforming operation serves to illustrate the relation between molecular structure and octane value. Normal octane has a very low rating while 2,2,4 trimethylpentane or iso-octane is rated at 100. The latter in pure form was too expensive prior to 1935 even for laboratory use. The development of methods for catalytically polymerizing high purity olefins which could then be hydrogenated to iso-octane soon made the octane standard a semi-commercial product. In 1935 tankcar shipments were made for military purposes and later improvements in manufacturing have since widened the market.

The necessity for fuels of naturally high knockrating has become more and more urgent as engine design has advanced. The point is being reached where

further addition of tetraethyl lead is said to be uneconomical, as well as impractical (7). Anti-knock improvement is not a straight line function of added lead; hence the value of the base stock must be raised. Engine parts such as valves and spark plugs are seriously affected by the decomposition products of knock-suppressors and further increases in lead content are at present believed to be out of the question.

Further Improvement by Polymerization

The yield of high quality motor fuels is being still further improved by advances made in the polymerization of refinery gases. Two types of plant are in operation (see *Chem. & Met.* Nov. 1935, p. 596-607). The first, which has many possible modifications depending on the type of feed and the end product desired, operates by the straight application of heat and pressure with controlled time. The second (8) employs a solid phosphoric acid catalyst. While both paraffins and olefins are being polymerized, the saturated gases must first be converted to unsaturates by thermal cracking after which they may be polymerized by either process. The possible end products range from hydrogen gas to heavy tar. Hence all conditions must be carefully controlled. The number of commercial plants is steadily increasing, with a potential annual production of nine billion gallons of polymer gasoline. When it is considered that this gasoline is produced entirely from hydrocarbon gases, either natural or cracked, the possible saving in crude oil is at once apparent.

Developments of the past few years have justified the predictions that polymerization would play an increasingly important part in the production of automotive and aviation gasoline. Now that 100-octane gasoline has become a commercial reality, the day of synthetic fuels is rapidly approaching in this country. In this field it is of incidental interest to note that hydrogenation is again receiving earnest consideration. Many authorities were apparently convinced a few years ago that the production of fuels by hydrogenating olefins had little prospect of becoming important for many years to come. The industry, however, is experiencing a steady expansion in cracking facilities which will produce ever greater volumes of unsaturated gases. Both polymerization and hydrogenation will be required to convert them into marketable fuels and lubricants.

Chemical industry and the chemical engineers in it are particularly interested in the fact that petroleum refiners are entering the chemical markets now as manufacturers where before they were consumers only. Starting in a small way liquefied petroleum gases produced in excess from cracking and stabilizing operations are now being widely used in sections of the country without natural or manufactured gas. In six years the industry has grown almost ten-fold—from nearly 5,000,000 gal. sold in 1928 (9) to over 48,000,000 gal. in 1934.

Petroleum research is making its mark on gasoline manufacture. Today over $12,000,000 is being spent annually in laboratories that employ over 3,200 engineers, chemists and physicists (1). As a result the older processes are being modified and in some cases even eliminated in favor of newer methods which produce the required results more precisely and more profitably. Indications point toward a continuation of this trend for many years to come.

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5. Stratford *et al, Refiner,* March 1938, p. 109
6. Saegebarth *et al, Refiner*, June 1937, p. 256
7. *Oil and Gas Journal,* March 25, 1937, p. 108
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9. *API, locus cit*. p. 120.

The author desires to express his appreciation to the Universal Oil Products Co. of Chicago and the Foster Wheeler Co. of New York, for their courtesy in supplying the photographs of recent refining units employing the catalytic polymerization process

Orderly and compact piping arrangement characterizes this largest and most modern catalytic polymerization plant. At left are the reactivation gas compressors; at right, the control room; in the background are two of the Axial Flow fans of the forced draft cooling tower

Bolt of fibrous glass cloth of a type used for gas filtration

Filtering Gas Through Glass

By W. H. ATKINSON
OWENS-ILLINOIS GLASS CO.
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Rapid progress in the development of satisfactory all-glass filter fabrics makes it probable that both gas and liquid filtration through these acidproof, heat-resisting inorganic media will soon become common. At the present, however, few full-scale application data are available and the following report on gas filtration is necessarily general. Somewhat later Mr. Atkinson promises to discuss commercial gas filtration performance in detail. Several months additional must elapse before reliable data on liquid filtration will be ready for publication.

FILTRATION is an extremely complicated problem, but one which is becoming more and more important to the chemical industry as well as to our everyday lives. Whereas some definitions of filtration limit the operation to one of clearing or purifying liquids, we have come to apply the word to the cleaning or purifying of gases as well. Always a vital problem in the chemical and metallurgical industries, this latter phase is becoming of greater import daily. No more evidence is needed than to consider the growth of the industrial dust collecting and air conditioning industries in the past few years.

The very word, "dust," generally creates a feeling of repugnance or dislike in most people, since we usually associate unpleasantness with direct contact with dust. But without dust it would never rain, as these particles form the nuclei for rain drops, and the earth would be continually enveloped in a cloud of vapor. To dust can be directly attributed some of the greatest beauties of nature, and our very existence in absolutely dust-free atmosphere is questionable. Dust is undoubtedly necessary to our existence, but at the same time it is a distinct menace to health and happiness, and as such there must be means of control.

To the average person dust is any foreign matter which has been or is suspended in air or gas, and the words "fume" and "smoke" are often used synonomously with "dust". One method of classification of these three has been based upon the method of formation of the material, in other words—*dusts* are fine particles of matter derived from natural sources; *fumes* are fine particles of matter, chemically formed; and *smoke* is a suspension of extremely fine particles of matter resulting from chemical changes, as in combustion.

The 1937 Guide Book of the American Society of Heating & Ventilating Engineers arbitrarily classifies these three as follows: "*Dusts* are particles of solid matter varying from 1.0 to 150 microns in size. *Fumes* include particles resulting from chemical processing, combustion, explosion, and distillation, ranging from 0.1 to 1.0 microns in size. *Smoke* is composed of fine soot or carbon particles, less than 0.1 microns in size, which will result from incomplete combustion of carbonaceous materials, such as coal, oil, and tobacco.

"The lines of demarcation of these three classifications are neither sharp nor positive. Dusts tend to settle without appreciable agglomeration. Fumes tend to agglomerate and smoke to diffuse. Generally speaking, particles less than 1.0 micron in size will remain in suspension as permanent impurities unless they agglomerate."

Dusts, according to the above definition based on particle size, may be further classified as either "natural" or "artificial." Natural dusts would be those formed by nature through volcanoes, wind erosion and organic decomposition, etc.; and artificial dusts as those made by mechanical means—as in coal mining, or chemically formed, as products of combustion. There is a certain amount of overlapping, yet this classification has been arbitrarily assigned to dusts in order to simplify matters. The problems attendant on the proper handling of natural dusts may best be left to those primarily interested in air conditioning. While artificial dusts such as result from power plant operation are considered a nuisance, both they and fumes formed by other chemical and metallurgical means are inevitable byproducts of the processes essential to our present high standards of living. In facing these problems, two avenues of attack are open. One lies in the more thorough control of dust-creating manufacturing processes, thereby greatly reducing the

dust problem; the other method of attack lies in a suitable method of gas filtration or dust collection.

The methods proposed for the filtration of gases and for other types of dust collection are many and varied. A survey of the patent literature will indicate the vast amount of time and energy devoted to this problem. Generally speaking, the more successful types are covered by the following classification: Gravity collectors; scrubbers and washers; centrifugal effect collectors; contact collectors employing impact and adhesive surfaces; electrostatic precipitators; and, finally, fabric filters. For the most part, in dealing with collectors, where the value of the solids being collected is of prime importance or the particle size varies over a wide range, the fabric filter is considered the most efficient single unit.

There are advantages and disadvantages to all types of collection equipment, as with anything else. As a general rule the recovery efficiency is one of the most important factors to be taken into consideration when one is confronted with a dust collection problem. This naturally suggests a fabric type filter. Up to the present time the use of these filters has been decidedly limited by conditions of the gas and solid matter and their effect on the available fabrics. In some few instances it was possible to use fine metallic screens, but for the most part cotton or wool were used. The organic character of these textiles was the dominant factor in the decision as to whether to use a fabric filter or another type of collector.

Advent of Practical Glass Textiles

Developments in the past few years have altered this picture considerably. There has been produced and made commercially available a completely inorganic textile in the form of fibrous glass. One of the most chemically inert and heat resisting materials, glass plays a part of great importance in the world today, and particularly in the chemical and allied industries. A textile material 100 per cent glass in composition overcomes the majority of objections previously raised to the use of fabric filters for gas filtration.

Consider some of the disadvantages to the use of organic textiles for gas filtration and how these have been affected by the advent of an inorganic acid-resisting textile:

Temperature of the Gas Being Filtered—Organic materials as a whole are not heat resisting, and cotton and wool are no exceptions. Where high temperatures are involved it has been necessary to install cooling systems in order that the heat of the gas will not be ruinous to the fabric. There is also the possibility of the fabric being ignited by sparks carried into the filter element.

Fibrous glass, being inorganic is not affected by the usual temperatures encountered but behaves as most inorganic materials. Indications are that these fabrics will withstand temperatures considerably in excess of those commonly used, without materially affecting their life. Naturally, sparks will not ignite glass and therefore fire hazard is eliminated.

Moisture Content of Gas—Both cotton and wool are known to swell when wet. A fabric made of these materials woven to proper porosity will offer considerably more resistance to the flow of air when this air contains moisture, by virtue of this swelling action. This results in increased draft loss across the fabric and eventually leads to blinding of the filter medium.

Glass will not absorb moisture, consequently there is no swelling of the fibers to cause a closing of the pores in the fabric. Owing to this fact it seems clear that there will be less effect of moisture on an element clothed with this material than on one using organic fabrics.

Acid Content of Gas—Most flue gases contain acid constituents which when combined with moisture have an exceedingly deleterious effect on organic materials used as filter media. The inherent acid resistance of glass is thus highly advantageous in this application and in comparison to ordinary metallic screens or organic fabrics, glass textiles are more stable from the standpoint of acid resistance.

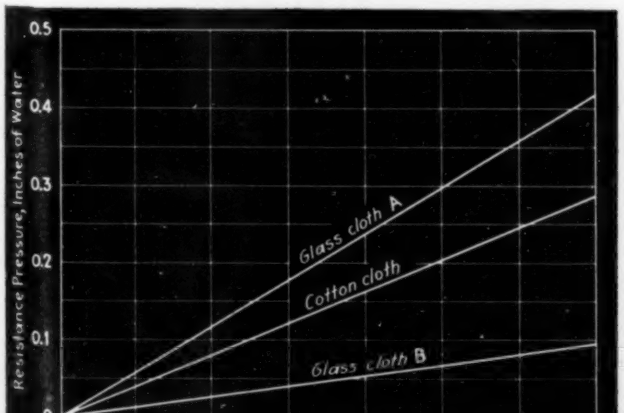
Fine Filaments Lower Draft Loss

Draft Loss and Blinding—The individual fibers of cotton and wool are more or less curly and comparatively coarse. The average cotton fiber diameter is between 0.0004 and 0.0008 in., whereas wool fibers average between 0.0008 and 0.0014 in. diameter. In a fabric constructed from yarns built up from fibers of this type there is a tendency for these curly fibers to cling tenaciously to solids, which eventually results in considerably increased draft loss and even permanent "blinding" of the fabric.

In producing glass in such a form that it can be used as a textile material, the individual filaments average between 0.0002 and 0.0003 in. diameter and are substantially non-curling. The tests that have been conducted seem to indicate less tendency toward blinding of the fabric, in other words, more uniform draft loss under a given set of conditions. These finer filaments tend also to permit greater "yarn porosity" when properly fabricated which indicates correspondingly lower initial fabric resistance.

These are the more important factors which have limited the use of fabric filters prior to this time. Some few objections have been raised, claiming short life for the fabrics due solely to mechanical wear because of the necessity for shaking down the entrapped solids. This factor is being completely investigated with regard to

Comparative resistances of filter fabrics to the passage of air at various rates of flow



the use of fibrous glass. Certain types of shake-down units are much more severe than others. The size and construction of the bag must be taken into account. Laboratory and semi-commercial tests indicate that these glass fabrics will perform satisfactorily over a period of years.

Wherever the use of any one type of gas filtration unit is indicated it is not merely a case of assuming that what will work for one job will work equally satisfactorily for another. Before a definite recommendation can be made, each individual case must be subjected to a careful and comprehensive survey and the data thus obtained thoroughly studied in connection with the results which may reasonably be anticipated when the full-sized unit is in operation. In the development of fibrous glass textiles for gas filtration purposes, a large number of laboratory tests have been run on many different types of fabrics. Considerable cooperative work has been done with engineers and technicians who have spent years working on problems relating to dust collection and gas filtration.

Without going into lengthy discussion of all the various tests conducted in the laboratory to determine some of the basic characteristics of fibrous glass textiles, the information given below will indicate one phase of the type of experiments being conducted.

How a Dust Filter Works

In any filter operation the fabric serves mainly as a backing for the filter matt. Naturally the fabric retains the first solids tending to pass through, but once a thin layer of these solids has been built up, the solids themselves act as the filter medium and the fabric as a supporting medium. As this layer of solids builds up, the pressure drop across the fabric increases until it is much higher than the drop across the clean fabric. But if the drop across the clean fabric is high it may necessitate several things. First, it may even require redesign of the equipment or replacement with a less efficient type wherein the draft loss is considerably lower. It may mean rapid "blinding" of the fabric, and will undoubtedly demand more frequent shake down periods. Therefore, if a fabric is obtainable which will show high filtration efficiency and low initial resistance to the flow of air it will undoubtedly be more suitable than a fabric which shows a high initial pressure drop and the same filtration efficiency.

The diagram on the preceding page portrays the resistance characteristics of three fabrics, two of glass and one of cotton. Laboratory tests indicate that the filtration efficiencies of the three fabrics are practically identical, and that they remove in the order of 99 per cent of the dust (weight basis) from the gas stream.

Requirements for Low Resistance

The explanation for the wide variation in resistance pressure between the two glass fabrics lies in the yarn construction and characteristics of the weave. In fabric "B" the yarn is comprised of a multitude of fine glass filaments loosely twisted, thus yielding yarn porosity. In other words, the gas in finding its way through the fabric finds the yarns themselves penetrable. The weave is sufficiently open to allow air to pass through readily, but the loose twisted yarns permit the filaments to project into and completely block the openings of the mesh. In fabric "A" the individual yarns are plied and tightly twisted, thus giving a so-called "hard" yarn, much less easily penetrable. There naturally is less fuzzing of this yarn and so, to obtain high filtration efficiency, it is necessary to weave the material tight; in other words the open voids are correspondingly smaller. The effect of such fabrication is to offer more resistance to the flow of air, which is definitely shown in the graph.

At this time it is difficult to draw conclusions from actual plant installations of units embodying fibrous glass as the filter medium, for sufficient data over sustained periods are not available. There have been installations, improperly designed, which have not performed with entire satisfaction. On the other hand, with units designed specifically for this material, or the design of which was such that no changes were necessary, operating characteristics have been found most satisfactory. In some instances performance has surpassed anticipated results.

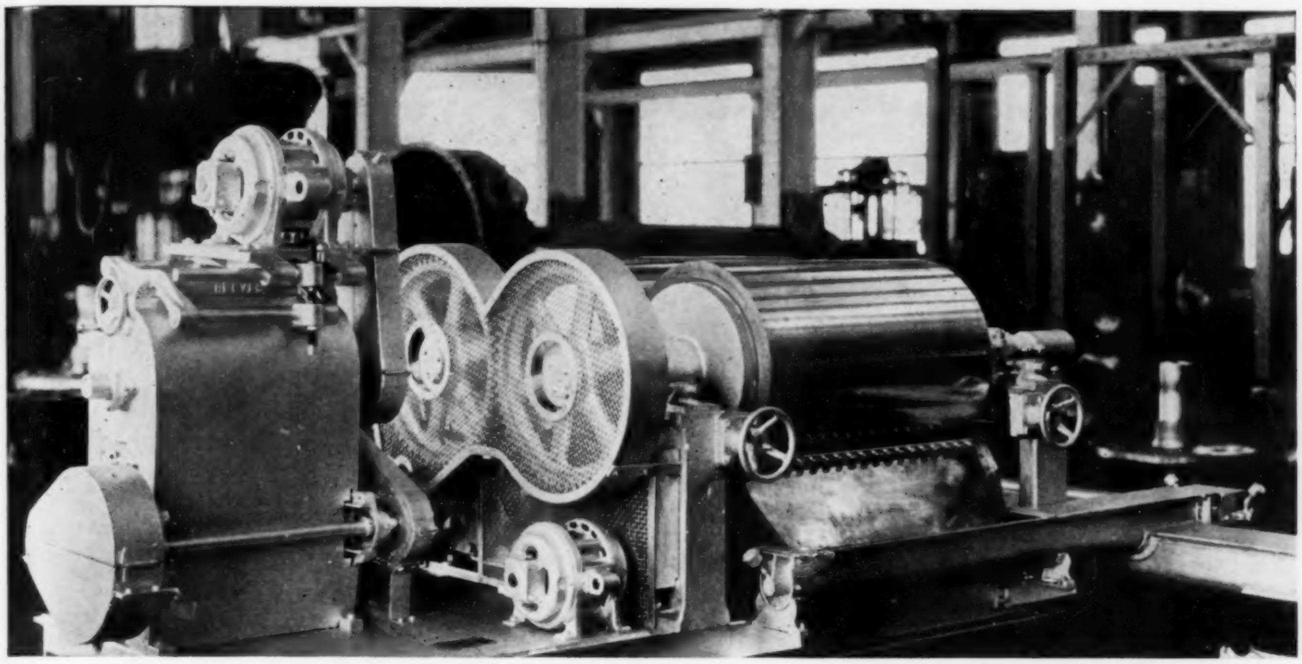
It is believed by those associated in this type of work that the future for the inorganic fabric filter holds definite promise. The advent of completely inorganic textiles will undoubtedly increase the possible uses for fabric filters and may even permit them to enter new fields.

Conference Finds Good Foremen Essential

INDISPENSABLE in the scheme of modern industrial management are good foremen and supervisors, in the opinion of the Personnel Division conference, recently held by the American Management Association in Chicago. For such men, management ability is still at least as important as good technical training.

T. G. Graham, Vice-president of B. F. Goodrich Co., cited better trained foremen with greater powers and responsibilities as an outstanding need of industry today. He declared that "Employers have strained their relationship with labor by dealing with the union heads without consulting with the supervisor or foreman who has more to do with employee relationship than either the executive or the union leader." A. B. Gates, Director of Training of Eastman Kodak Co., feels that the responsibility of management has not been changed by recent developments in industrial relations and that effective training of supervisors and foremen is possible if the company management understands the need of such training.

L. A. Appley, Supervisor of Training and Education of Socony Vacuum Oil Co., personalized the educational program of industry employees and the foreman's place in it by stating that "the foreman is it." "Supervision and foremanship has at its command a huge reservoir of knowledge of the technique of directing people." His contention is that the foreman or supervisor has lost so much of his usefulness and prestige by the use of specialists to take over special aspects of the foreman's duties that he has become little more than an inspector. To improve labor relations his challenge was "Give back the foreman and the supervisor his job."



An atmospheric twin drum dryer of the type discussed on page 181. The drums are 32 in. x 52 in. and chromium plated. Used for drying pharmaceuticals, the dryer is equipped with a splash feed, variable speed transmission and screw conveyors.

EFFECTIVE DRUM DRYING BY PRESENT-DAY METHODS

By GUY N. HARCOURT
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ONE OF THE OLDEST chemical engineering unit operations is that of drying. It may be accomplished by various means, most of which may be resolved into three basic divisions—mechanical, chemical, and thermal. Examples of the first two are found in centrifuging, pressing, freezing, absorption, adsorption, etc. However, most drying processes, in the usual sense of the word, come under the third division—thermal means.

As it is usually defined, the operation of drying consists of removing relatively small quantities of water from a solid or semi-solid material. However, the line of demarcation between the unit operations of drying and evaporation is not very sharply defined. Both operations have to do with the removal of a liquid from a solid, a solution or an extremely viscous material. Usually the liquid is water. In those cases where alcohol, gasoline, or some other volatile solvent is removed, the process may often be termed distillation. Sometimes the value of the vaporized material is used as a distinguishing factor. An example often used by the author to illustrate these differences is that of a solution of salt and water being boiled. If pure water is the product sought, the process is usually called distillation and it is carried on in a still; if the water is to be discarded and the salt recovered as the product, the operation is referred to as evaporation and is performed in an evaporator. The equipment used in both processes, however, may be identical. Further, the wet salt discharged from the evaporator may be subjected to a drying operation in which the remaining moisture is removed.

Numerous theories as to the mechanism of drying have been presented from time to time. In 1928 Sherwood stated that there were three possible distinct stages in the process of drying solids by evaporation from exposed surfaces into a moving gas. As set forth by Newman (*Trans. A.I.Ch.E.* **27**, p. 203, 1931), this theory further states that the first stage is that in which the surfaces remain wet and the rate of drying is constant, the second stage is that during which the surfaces are partially wet and the rate of drying falls off as they become less wet, the third stage begins after the surfaces have dried down to equilibrium with the gaseous drying medium and the rate of drying is completely controlled by diffusion from the interior of the solid.

Classification of Drying Methods

Classification of drying methods is a subject far from standardized. As a matter of fact, there are very nearly as many classifications as there are expert observers in the drying field. Walker, Lewis and McAdams make two general divisions—intermittent and continuous dryers. Becker (*Chem. & Met.* **38**, p. 94, 1931) also makes two general divisions—atmospheric and vacuum dryers. Badger and McCabe classify dryers according to the type of material being handled, i.e., materials in sheets or masses, granular or loose materials, pastes or solutions,

etc. As the author sees it, there is little point in trying to classify dryers according to the type of material being dried. One material may quite easily be dried on a half dozen different types of dryers, the choice depending on the condition of finished product desired or the overall cost of drying.

A more practical classification in many respects is one based on the method of heat application. In this system we have two general divisions: (1) Those dryers in which an intermediate circulating medium such as heated air or flue gas both supplies heat and carries away the moisture; and (2) those dryers in which the heat is supplied directly by radiation or conduction from a heated surface, rather than by the medium carrying the moisture away. In the first class are grouped atmospheric compartment and tunnel dryers, spray dryers, rotary hot air dryers, etc., which are used for a number of materials such as wood, cloth, dyes, lithopone, milk, etc. In the second division may be classified cylinder, agitated pan, vacuum shelf, steam tube, and drum dryers. These dryers may be used for milk, dyes, soap, paper, spent grain from distilleries and breweries and other materials which may be brought into direct contact with the heated surfaces of the dryer itself.

It is the purpose of this paper to deal only with those contact dryers under the general head of drum dryers.

Common Double Drum Type

An *atmospheric double drum dryer* is shown in Fig. 1. It consists of two perfectly smooth steam-heated drums rotated toward each other from the top, a trough feed mechanism and knife scrapers. The liquid or slurry to be dried is fed into the V-shaped trough formed by the two drums and two end boards. Material immediately adjacent to the drum adheres in a thin film and is carried around to the knives where it is scraped off and falls into a conveyor.

There are four variables involved in the operation of this type of dryer on a given material. They are: (1) steam pressure, which governs the temperature of the drum surface; (2) speed of rotation, which determines the time of contact between the film and preheated sur-

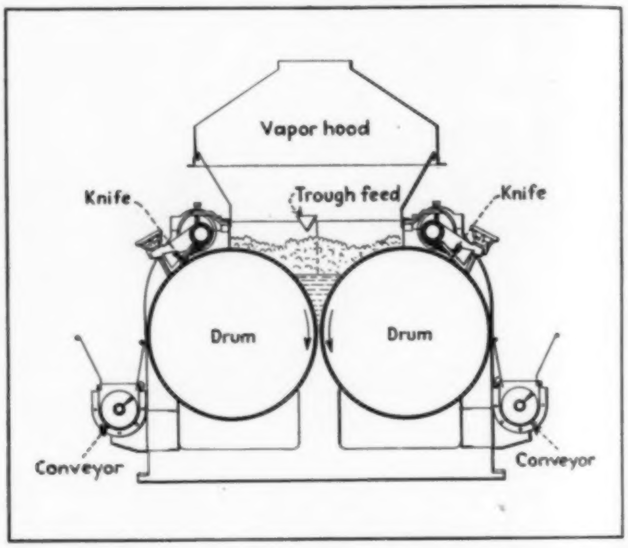


Fig. 1—An atmospheric double drum dryer of this type may be used for liquids, slurries, sludges, or pastes, depending on the type feed mechanism used

Table I—Atmospheric Double Drum Dryer

Material Dried	Type Feed	Moisture in Feed Per Cent	Steam Pressure Lb./Sq. In.	Drum Speed R.p.m.	Feed Temp. Deg. F.	Product Lb./Hr./Sq. Ft.	Water in Product Per Cent
Sod. Sulphonate..	Std.	53.6	63	8½	164	7.75	6.40
Sod. Sulphate....	Std.	76	56	7	150	3.08	0.06
Sod. Phosphate...	Std.	57	90	9	180	8.23	0.9
Sod. Acetate.....	Std.	39.5	70	3	205	1.51	0.44
Sod. Acetate.....	Std.	40.5	67	8	200	5.16	10.03
Sod. Acetate.....	Std.	63.5	67	8	170	3.26	9.53

Table II—Twin Drum Dryer

Material Dried	Type Feed	Moisture in Feed Per Cent	Steam Pressure Lb./Sq. In.	Drum Speed R.p.m.	Feed Temp. Deg. F.	Product Lb./Hr./Sq. Ft.	Water in Product Per Cent
Sod. Sulphate....	Dip	76	55	7	110	3.54	0.85
Sod. Sulphate....	Top	69	60	9½	162	4.27	0.14
Sod. Sulphate....	Top	69	32	9½	116	3.56	5.47
Sod. Sulphate....	Splash	71	60	6	130	4.30	0.10
Sod. Sulphate....	Splash	71.5	60	12	140	5.35	0.17
Sod. Sulphate....	Splash	71.5	60	10	145	5.33	0.09
Sod. Phosphate...	Splash	52.5	58	5½	208	8.69	0.59
Sod. Phosphate...	Dip	55	60	5½	200	6.05	0.77
Sod. Sulphonate..	Top	53.5	63	8½	172	10.43	8-10

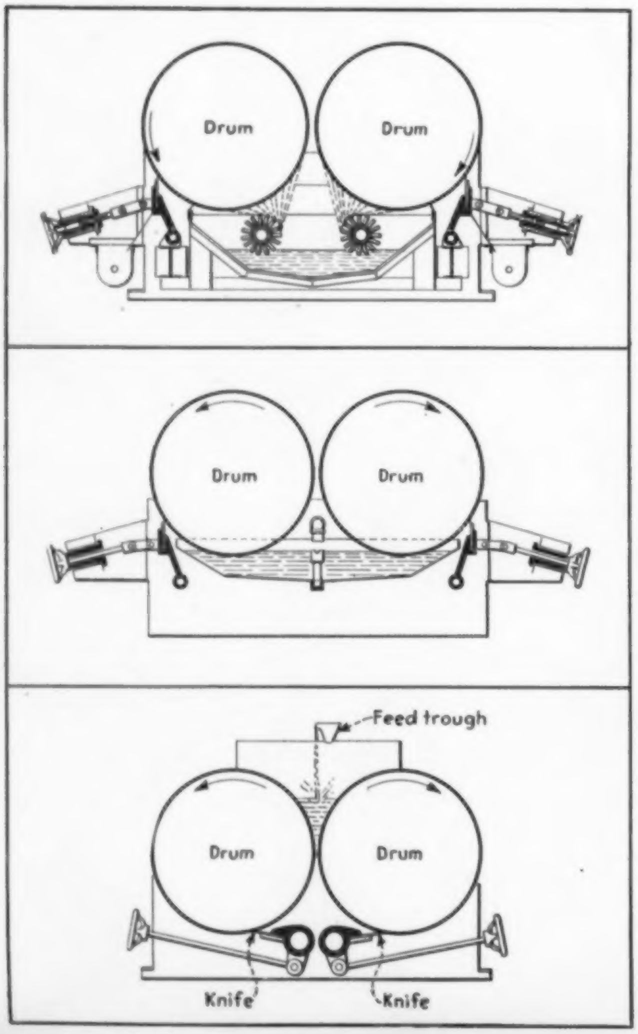


Fig. 2—Atmospheric twin drum dryers (left) differ from double drum dryers (Fig. 1) in several respects, the most important of which is the direction of rotation of the drums. The consequent absence of end boards offers many advantages. Three types of twin drum dryers are illustrated here: *a*) splash feed, *b*) dip feed, and *c*) center feed

Table III—Single Drum Dryer

Material Dried	Type Feed	Moisture in Feed Per Cent	Steam Pressure Lb./Sq. In.	Drum Speed R.p.m.	Feed Temp. Deg. F.	Product Lb./Hr./ Sq. Ft.	Water in Product Per Cent
Chrom. Sulphate.	Spray	48.5	50	5	...	3.69	5.47
Chrom. Sulphate.	Dip	48.0	50	4	...	1.30	8.06
Chrom. Sulphate.	Pan	59.5	24	2½	158	1.53	5.26
Chrom. Sulphate.	Splash	59.5	55	1¾	150	2.31	4.93
Chrom. Sulphate.	Splash	59.5	53	4¾	154	3.76	5.35
Chrom. Sulphate.	Dip	59.5	53	5¼	153	3.36	4.57
Vegetable Glue...	Pan	60–70	20–30	6–7	...	1–1.6	10.12
Cal. Arsenate....	Slurry	75–77	45–50	3–4	...	2–3	0.5–1
Cal. Carbonate...	Slurry	70	45	2–3	...	1.5–3	0.5

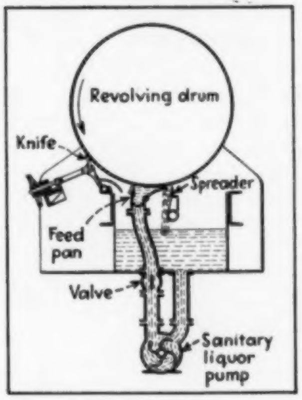


Fig. 3—The atmospheric single drum dryer is the original drum dryer. This one is shown with the pan feed used for vegetable glues, etc.

face; (3) thickness of film, which may be governed by the distance between the drums; and (4) condition of the feed material, i.e., the concentration and temperature at which the solution to be dried reaches the drum.

The capacity of the dryer may be increased by increasing the speed of rotation, the steam pressure, or the temperature and concentration of the feed. Physical characteristics of the dried material depend to a large extent on the thickness of the film, i.e., a thick film should produce flakes, and a thin film will tend to form a powder. It is evident that these four variables cannot be varied at will; characteristics of the material being dried play a large part.

A number of advantages of this type of dryer immediately suggest themselves. One of them is that all the material fed to the drums is dried, another is the ease of cleaning, a third is the ease with which the feed may be changed from one material to another, and still a fourth is the good correlation between results obtained on a small laboratory model and a plant-sized dryer.

Of all contact dryers, the atmospheric drum dryer is said to have the widest range of application. It may be used for drying dilute or concentrated liquids, sludges, slurries, etc. In the case of dilute liquids, the solution in the trough between the drums usually boils vigorously, adding to the capacity of the dryer.

A number of tests have been conducted on the atmospheric double drum dryer using milk as a drying material by C. O. Lavett and D. J. Van Marle of the Buffalo Foundry & Machine Co. The results of these tests have been summarized as follows:

	Variable Increased			
	Steam Pressure	Feed Tempera-ture	R.p.m. of Drums	Distance Between Drums
Film Thickness	Increase	Increase	Decrease	Increase
Evaporation between drums	Increase	Decrease	Increase	Decrease
Evaporation on drums	Increase	Increase	Decrease	Increase
Total heat transfer	Increase	Unchanged	Unchanged	Unchanged
Moisture content powder	Decrease	Decrease	Increase	Increase
Concentration between drums	Decrease	Decrease	Increase	Decrease

Table I on the opposite page gives the results of various tests taken at random on atmospheric double drum drying of certain chemical solutions. For comparison similar tabulations for drying on other types of drum dryers are given on the pages that follow. A study of the tables yields a somewhat quantitative conception of the effects of steam pressure, drum speed, and feed temperature.

Offspring of Double Drum Dryer

The *twin drum dryer* was developed to satisfy specific needs for which the atmospheric double drum dryer was found inadequate. In those installations of the double drum type where solutions of inorganic salts were being dried, boiling and concentration were always effected. Consequently, lumps or crusts of the material often accumulated on the end boards or splash shields of the dryer, from whence they fell between the drums, and because of their firmness, forced the drums apart. This action sheared off shear pins which were provided as a safety device, and caused considerable loss of operating time while these pins were being replaced and the drums readjusted.

Designed to eliminate this difficulty, the twin drum dryer (Fig. 2), differs in two essential characteristics, namely, the direction of rotation of the drum and the method of feeding. Three systems of feeding are in common use—splash, dip, and center feed.

The splash feed type shown in Fig. *2a*, consists of two steam-heated drums similar to those in Fig. 1, but rotating in the opposite direction; however, the machine also differs in that the pool of solution is below the drums and the material is transferred to them by means of two rotating splashers. As a consequence, the doctor knives or scrapers are also located at a different place on the drum. This system has been found very satisfactory for drying a solution containing more than one salt. In other methods the salts crystallize out progressively giving a product that is not uniform. However, the product of the twin drum dryer is entirely homogeneous. The splash feed does, of course, introduce another variable to the four mentioned above, in that both the speed and direction of rotation of the feeding rolls affect the capacity of the dryer and physical characteristics of the product.

Dip Feed for Adherent Materials

In the dip feed dryer (Fig. *2b*), the heated drums dip slightly into a solution of material to be dried. The solution is maintained at a uniform level in a shallow pan by means of an overflow pipe. Unevenness in the coating may be rolled out by careful adjustment of the clearance

between the drums. This method is especially applicable to solutions of comparatively high concentration.

The third variation, the center feed type dryer (Fig. 2*c*) is very similar to the atmospheric double drum type described above. Its principal difference is in the direction of rotation of the drum and the position of the doctor blade on the periphery of the drum. Here the thickness of coating is controlled only by the rate of rotation of the drum, consequently an extremely high capacity may be obtained with this type of dryer. In some cases it is necessary to use spreader rolls to control the drum coating. It is possible to produce a product having any moisture content up to 25 per cent, by merely regulating the rate of rotation and controlling the thickness of the film coating.

An advantage not to be overlooked in considering this type of dryer is the possibility of combining its use with the use of a continuous rotary dryer. The center feed drum dryer can produce with high capacity a coarse granular product which is dry enough to use as feed for the rotary dryer, where complete dehydration is effected. Low cost is the principal advantage of this combination. Producing an anhydrous product from a salt soluble in its own water of crystallization, however, is another notable achievement of the combination.

Original Drum Dryer

The *single drum dryer* is the original type of drum dryer (See Fig. 3). Recently it has been replaced in many of its applications by the double or twin drum dryer; however, for certain materials it is particularly adapted. Sticky materials such as glues and resins accumulate between the end boards of the drums of double drum type so that the power consumption becomes excessive; the single drum dryer does not have this difficulty. Drying in which the feed is in the form of a slurry and the product is to be light and fluffy, such as in drying insecticides, is also peculiarly adapted to the single drum dryer.

Lower steam pressure is an inherent limitation in the single as compared with the double drum dryer. The reason for this is quite obvious from the following example: To obtain the same drum surface area as a 42-in. x 100-in. double drum dryer, requires a 60 x 144-in. single drum dryer. But using the same wall thickness and allowable stresses, the allowable steam pressure in the two dryers would be in the ratio of 60 to 42; so if the 42-in. roll had a maximum working pressure of 100 lb. per sq.in., the 60-in. roll would be limited to a maximum of 70 lb. However, when other features of design are also taken into account, the maximum working pressure on the 60 in. drum is further limited to about 50 lb. per sq.in. with the ultimate result that the capacity in lb. per sq.ft. of the single drum dryer is reduced below that of the double drum type. These remarks are, of course, quite general, and individual designs may vary considerably from this standard.

Dip, splash, pan, weir and slurry feeds, similar to those described above, may be applied to this type of dryer as well as the twin drum type.

Drum Drying In Vacuum

Some materials requiring drying such as food products containing enzymes and vitamins, proteins, etc., are adversely affected by heat. For other materials the presence of air is undesirable as it allows oxidation to take place. In some cases it is necessary to recover a valuable solvent from the drying solution. For all these cases it is desirable to carry out the drying operation at a low temperature and in a vacuum.

Originally the *vacuum drum dryer* was made by merely inclosing an atmospheric single drum dryer in an airtight casing and allowing it to run under vacuum. A few changes were, of course, necessary; a diagramatic sketch of the results is shown in Fig. 4. Auxiliary equipment usually consists of a wet dust collector, a condenser and a vacuum pump. The product is removed by a screw conveyor which delivers it into a receiver, and in most cases the machines are supplied with two receivers so that the vacuum may be broken in one for discharging while the other is being filled.

A great amount of skill is required in both construction and operation of the vacuum drum dryer because in addition to the complication inherent in maintaining a vacuum, the materials being dried are frequently delicate or valuable and must retain such properties as taste, odor, etc.

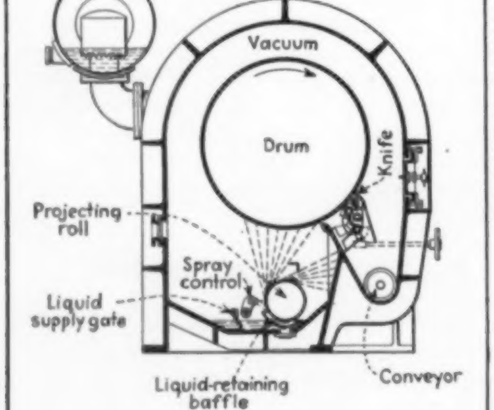


Table IV—Vacuum Drum Dryer

Material Dried	Type Feed	Moisture In Feed Per Cent	Steam Pressure Lb./Sq. In.	Drum Speed R.p.m.	Vacuum In. Hg.	Product Lb./ Hr./ Sq. Ft.	Water in Product Per Cent
Extract..........	Pan	59	35	8	27.9	7.74	4.76
Extract..........	Pan	59	35	6	27.7	2.76	1.92
Extract..........	Pan	59	36	4	Atm.	2.09	1.01
Extract..........	Pan	56.5	35	7½	27.5	1.95	3.19
Extract..........	Pan	56.5	50	2½	Atm.	1.16	0.75
Skim Milk.......	Pan	65	10–20	4–5	....	2–3	2.5–3.2
Malted Milk.....	Pan	60	30–35	4–5	....	2	2.6
Coffee...........	Pan	65	5–10	1–1.5	....	2–3	1.6–2.1
Malt Extract....	Spray	65	3–5	0.5–1	....	3–4	1.3–1.6
Tanning Extract..	Pan	50–55	30–35	8–10	....	8–10	5.3–6.4
Vegetable Glue...	Pan	60–70	15–30	5–7	....	10–12	2–4

Fig. 4—Vacuum drum dryer with spray film feed, especially useful for materials which must retain taste, odor, etc.

A Thousand Feet of CONTINUOUS PICKLING

Two 505-ft. lines serve world's largest strip mill in new plant of Republic Steel Corp.

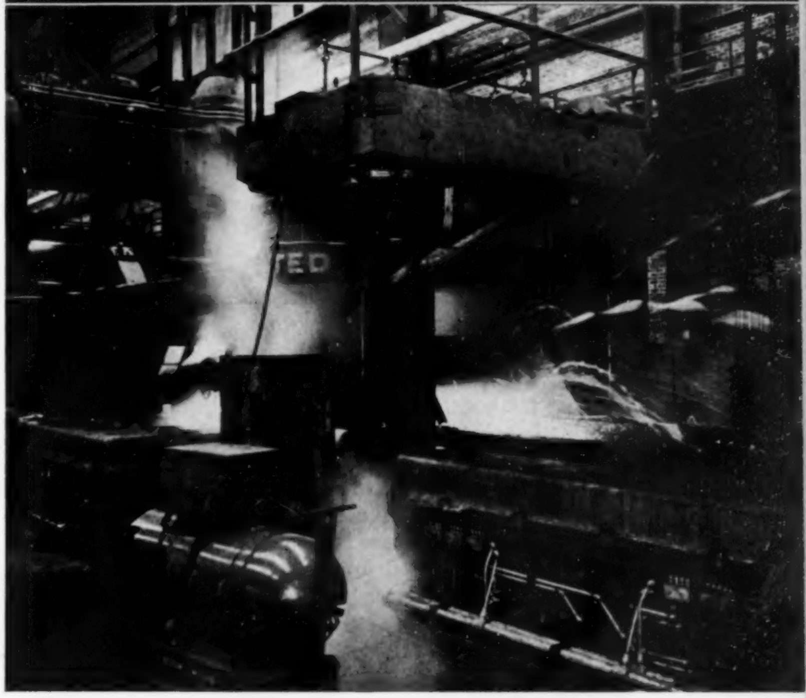
THE STEEL INDUSTRY is turning from traditional batch to continuous processing—as evidenced by the formal opening on March 15 of Republic Steel Corp.'s 98-in. continuous strip mill. The cold billet merely crawls through the continuous slab furnace, but when it comes out hot and starts on its 25-mile-an-hour journey down the mill there must be no turning back. Specification in dimension, finish and texture must be on dot at first shot.

Not the least important of the operations from a chemical standpoint is the continuous pickler that turns out the clean, bright coils of hot rolled strip for cold finishing. Two 505-ft. long continuous pickling lines are required to serve the output of the huge mill—the largest and fastest of its kind.

Each pickling line consists of an uncoiler, a quick operating shear for squaring off strip ends, stitcher, looping pit, pinch rolls, four sulphuric acid tanks, a cold water tank, a hot water tank, dryer, additional pinch rolls, a shear for cutting out stitches, and recoilers. Speed of the line is between 40 and 160 ft. per min. Temperature of the pickling tanks, maintained at about 185 deg. F., is controlled by 10 pyrometers, 5 in each line. Acid in the pickling solution averages between 8 and 12 per cent.

Looping pits, concrete lined with wood, are 22 ft. long. The acid tanks are of steel plate construction, all welded, lined with ¼ in. rubber and faced with brick bonded with a special sulphur compound. Covers on the acid and hot water tanks are of rubber-lined steel. An exhauster fan for each tank pulls the acid fumes through a water spray scrubber and discharges them into the open air through a rubber-lined stack. Each acid tank has a capacity of about 13,000 gal. and each water tank, 4,000 gal. Contents are changed by syphoning. In each acid tank is a dancer roll mechanism which is connected to the pinch roll speed rheostat to keep automatical the catenary between the support rolls at the proper point. Hot air blown on the strip in the dryers to prevent water from staining the strip is under enough pressure to blow off the water as well as evaporate it.

The mill rolls strip steel 94 in. wide from slabs which speed through a series of electrically controlled roughing and finishing mills to the coiler almost a quarter of a mile away in as little as 4 minutes. Steel moves through this mill at speeds up to 2,121 ft. per min. and is wound into coils weighing as much as 12,500 lb. a piece. The plant has a capacity for production of a million tons of hot and cold rolled sheet and strip per year.

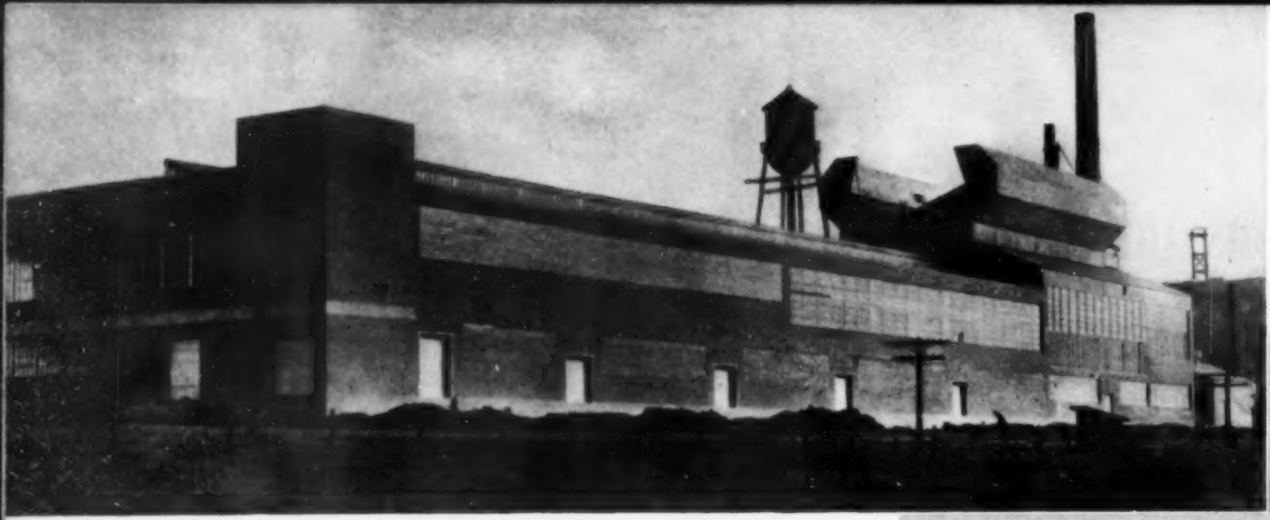


Upper—Delivery end of the two 505-ft. long continuous pickling lines at Republic Steel Corp.'s new strip mill

Lower—A slab just discharged from one of the slab heating furnaces at the new 98-in. strip mill at Cleveland

The most modern types of handling equipment; electrical devices which give absolute control of working temperatures and speeds throughout the hot rolling, pickling, annealing and cold rolling departments; and scientific lighting provide efficiency and ideal working conditions throughout the plant

The continuous pickler turns out clean bright coils of hot-rolled strip for cold finishing. The stock, still full-hard, goes to Brown thermocouple-controlled gas-fired annealing ovens in boxes under Kemp-controlled reducing atmospheres for brightness. Important electro-mechanical ingenuities are built into this part of the plant which might well be of keen interest to processing men.



How

Above—Main processing building of the Port Allegany, Pa., mill of Pittsburgh Corning Corp. Note two batch storage bins on the roof. Right—Silos for raw materials storage are at the extreme right

By JAMES A. LEE
MANAGING EDITOR
CHEMICAL AND METALLURGICAL ENGINEERING

GLASS BLOCKS have a dual interest for the chemical engineer. First, they offer him a material for use in plant construction possessing a new combination of features, and secondly, they are made by chemical engineering methods. Such blocks are being produced by the Pittsburgh Corning Corp., a new subsidiary organization formed by the Corning Glass Works and the Pittsburgh Plate Glass Co. to specialize in the development, production and sale of certain types of structural glass products. The new plant is located at Port Allegany, Pa. Production commenced in February.

The plant is composed of a group of raw material storage silos, mixing building, compressor house and main processing building. The principal structure of 400 ft. in length and 80 ft. in width has two floors. The upper floor is devoted to processing and contains the melting tank, forming machines and lehrs and it is here that the inspection and packaging is done. The lower floor contains the mold and machine shops, storage and shipping facilities.

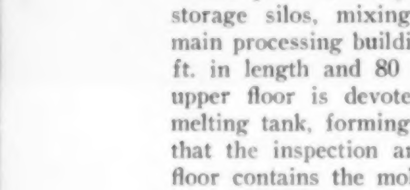
The tank section of the building is provided with a monitor type ventilator on the roof. The side walls are constructed of steel sash and corrugated iron with panels on trunnions. This entire end of the building can be opened in the warm months of the year. The central part of the building has corrugated iron walls insulated with glass wool, while the inspection and finishing end of the building has brick and glass block walls on one side and at the end. The entire north side of the building is covered with corrugated iron. This temporary covering can be removed easily if future requirements demand the installation of a second unit. Straight line flow of materials is a feature of the plant layout.

A one-story building providing storage for the materials used in small amounts and space for the weighing and mixing equipment, and the raw material storage silos make-up a group of structures located a short distance from the main building. The sand silo has a capacity of 900 tons. Two other silos have capacities of 400 tons each. They are divided into 4 sections by vertical partitions so that shipments can be segregated. The fourth silo used for cullet, has a capacity of 50 tons. It is loaded by a special bucket elevator.

Raw materials consist of glass sand from Mapleton, Pa., limestone from Gibsonburg, Ohio, feldspar from South Dakota and soda ash from Barberton, Ohio. On arrival at the plant the sand and other materials are unloaded from the railroad cars into a track hopper. A bucket elevator delivers the material to a belt conveyor on top of the silos. This is equipped with a traveling tripper in order that the load may be discharged into any particular bin.

The floor of the silos is about 15 ft. above the ground. Sand, feldspar and other materials for a batch are discharged by gravity from the silos directly into the automatic weigh hoppers below. From these hoppers the materials are discharged onto a gathering belt which delivers them to the revolving cylindrical batch mixer located in the batch house at the north end of the silos. Wherever practical, weighing equipment and conveyors are automatically operated and every precaution has been taken to make the entire batch mixing operation dustless.

Ingredients of the batch after being mixed are discharged into batch buggies that are transported by storage battery trucks to a pit hopper on the out side of one end of the main building. A bucket elevator carries



Companion radius block of the Argus pattern. These are made in the 5¾ and 7¾ in. sizes. The mortar edges of the blocks are given a special bond coating treatment

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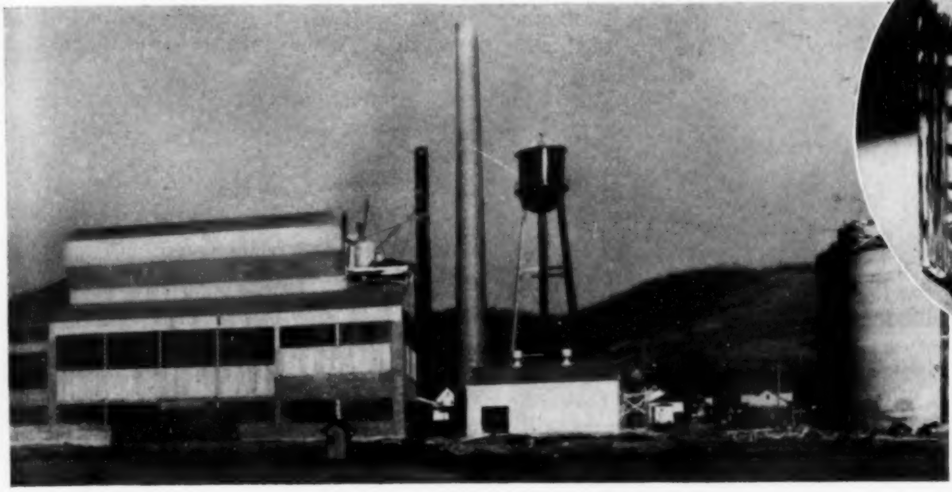
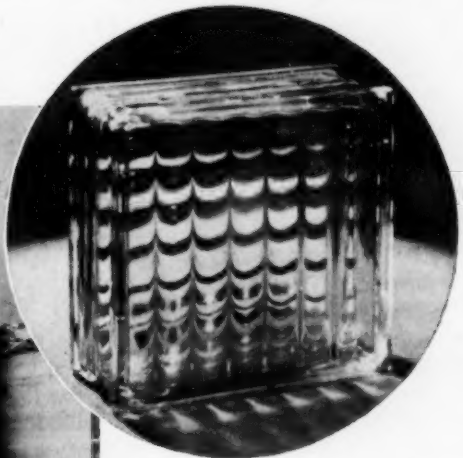
Glass Blocks Are Made





Argus pattern of glass block is available in several sizes

the batch of materials into one or the other of two storage bins on the roof. Each bin has a capacity of 25 tons. The mixture of raw materials feeds from the overhead storage to the tank within the building below.

The end of the tank where the melting is done is 18 ft. wide and 32 ft. long from back wall to bridge, with a depth of 39 in. The bridge wall is 42 in. wide with a throat at the bottom center leading into the refining end, which has a depth of 27 in. The nose of the tank has a radius of 10 ft., center of the arc being 2 ft. in front of the bridge wall. The melting capacity of the tank is 80 tons per 24-hr. day.

The natural gas used for heating the tank enters through eight openings, four on each side. Gas and air passages and the regenerators extend down to the lower floor where they connect with the flues beneath the floor. These flues lead to a reversing valve which is connected through another short flue to the stack.

Raw materials are fed into the tank by two automatic charging machines. These machines are regulated so that the mixture is fed into the furnace in uniform quantities and in such amount as is required to keep a constant level of molten glass in the tank.

The molten glass pours from the tank throat through three forehearths, the temperatures of which are automatically controlled. It feeds into presses making the half blocks of three sizes.

From the presses the half blocks are carried along on a steel belt conveyor to the sealing machines where they are assembled. The halves are automatically sealed together while still at a high temperature and without the use of a metal or other binding material. Sealing the blocks at a high temperature creates a partial vacuum on cooling to normal temperatures.

Blocks move along to the four lehrs where they are annealed and cooled. Temperature of the gas fired lehrs is regulated at 24 different points in the tunnel. Each lehr is a complete unit and is mounted on wheels so that it can be moved about with ease. The blocks move through the lehrs on chain belt conveyors. Several hours are required for the blocks to pass through the 110 ft. tunnel.

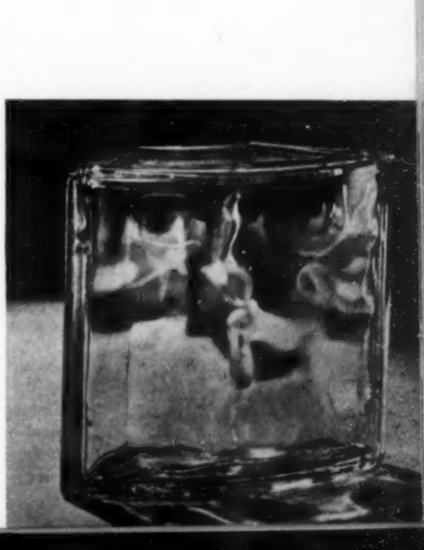
Each block is given a careful visual inspection as it leaves the lehr. They are then tested for leaks by passing through an 18 ft. trough of water. The four mortar edges of the blocks are next given special bond coating treatment.

Completed blocks are packed in paper cartons and sent to the lower floor where they are temporarily stored and then shipped. The blocks and cartons are carried from one point to another in the building on roller conveyors. A railroad siding extends the length of the plant.

Two styles of glass blocks are being produced, Argus and Decora, each pattern in three sizes, $5\frac{3}{4}$x$5\frac{3}{4}$x$3\frac{7}{8}$, $7\frac{3}{4}$x$7\frac{3}{4}$x$3\frac{7}{8}$ and $11\frac{3}{4}$x$11\frac{3}{4}$x$3\frac{7}{8}$ in. There is a companion radius block for the $5\frac{3}{4}$ and $7\frac{3}{4}$ in. sizes. A block of the Argus pattern is shown in the accompanying illustration at the top of this page. Radius blocks of both patterns for use in corners appear in illustrations at a lower corner of this and the facing page.

Plant production is in charge of L. O. Griffith, superintendent, and O. W. Wiley, assistant superintendent. The former was connected with the McBeth-Evan Glass Co. The latter was employed by the Corning Glass Co. in the Fiber Products Division.

Companion radius block of the Decora pattern. Glass blocks are finding their way into many process industry plants because windows of these blocks can be constructed in place of the steel frames which corrode



Points to Watch in Buying and Selling Patents

By H. A. TOULMIN, Jr.,
TOULMIN & TOULMIN
DAYTON, OHIO

HERE are some very important points to watch in buying and selling patents, or licenses under them:

1—If you take a note in payment for a patent you sell be sure that the note bears on its face the notation, "Given for a patent right." In some states it has been the rule that failure to do so will not only prevent your collecting the note, but if you discount the note you may be subject to a fine and a jail sentence.

2—When buying a patent be sure to have the assignment recorded within three months, otherwise the seller may, if he is dishonest, sell it to someone else, who, if he is more diligent than you in recording the assignment, will own the patent and you will have no rights under it.

3—In licensing another under your patent, or in buying the right to manufacture under another's patent, have a cancellation clause in the contract, for changing conditions or unforeseen difficulties may make the original contract unsatisfactory to you.

4—In any contract for sale or purchase of rights under a patent, specify who is to prosecute infringers, who is to pay for the lawsuits, who is to bring them and who is to share in any recoveries.

5—Before buying rights under a patent, make certain, for yourself, that the construction disclosed in the patent which you intend to make and sell does not infringe anyone else's prior patent. This is an obvious precaution that is often neglected by overly enthusiastic purchasers of what looks like a good thing in patents.

6—Settle before-hand whether the inventor or the purchaser is to control the prosecution of the application for the patent in the patent office. If the inventor controls, he is apt to expand the claims unduly with the result that the purchaser finds himself tied up to pay royalties on patents which turn out to be worthless. If the manufacturer controls the application he may make the patent cover so narrow a scope that he can manufacture many of the products that should have been covered, without paying royalties.

7—Be careful of the wording in a license agreement. Remember that while "license" means to rent, if the agreement reads that the purchaser grants an *exclusive* right to make, use and sell the invention, the patent has actually been sold, if the rights given are coextensive for the whole of the United States and its possessions. If the exclusive rights are for a certain territory only, the sale is for that territory only. However, such arrangements are prolific of trouble as a rule. With the above exception understood, then the use of the word "license" means that the arrangement is a rental. Of course, outright assignment of a patent is a sale.

8—In licensing another under your patent it is well to provide for a minimum royality to be paid you whether or not the buyer manufactures under your patent, otherwise you may have disposed of your rights for nothing.

9—Be careful in drawing up royalty agreements, for they are frequent causes of lawsuits. This is the place where your patent lawyer can be your best friend. The most common plans are: a) minimum royalty with definite amount per article manufactured above the minimum quantity; b) a sliding scale providing for decreased royalty per article as the number of articles made or sold increases; c) a conditional sale with a down payment and additional payments periodically either in specified sums or based on the number of devices made and sold.

Royalties may be so much per article, a percentage of net profit or a percentage of gross profit. The trouble with the first method is that the margin of profit may fall as competition of other devices arises. To determine net profit requires rather elaborate auditing and is a common cause of disagreement and lawsuits. The percentage of gross profit is easier to determine and on the whole usually the most satisfactory method.

10—When buying patents it is common for the buyer to specify that the inventor shall sell to him all future improvement inventions in that field. Make the inventor put that into writing telling in detail just what inventions he will turn over to you. Controversy often arises here as to whether certain patents which more or less overlap, or are related to the field, come within the agreement.

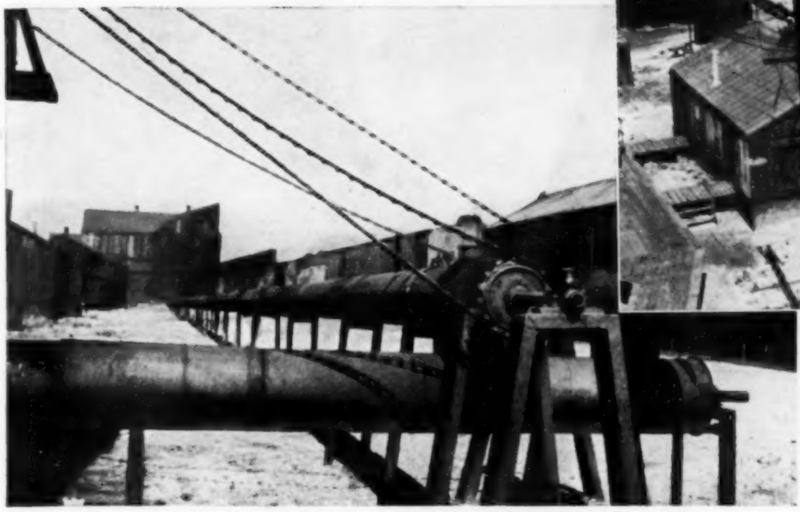
Remember that until a patent can be referred to by number or specific date or other specific means the Patent Office cannot recognize an assignment. An agreement to transfer future patents depends for its fulfilment upon the honesty and financial responsibility of the inventor.

11—When selling rights under a patent, include in the contract provisions for the return to you of the rights if the buyer fails or goes out of business.

12—Finally, when drawing contracts for purchase or sale of a patent, or rights, under it, consult your own patent attorney.

What Is the Ideal Plastic?

EACH of the commercial plastics offers a combination of merits and deficiencies which determine its field of usefulness. After giving a proposed definition of a plastic, A. F. Randolph of the E. I. du Pont de Nemours & Co., Arlington, N. J., at the symposium on plastics held during the recent meeting of the American Society for Testing Materials at Rochester, N. Y., outlined properties of an ideal plastic. Low cost was indicated as most important; specific gravity should be low since the cost per volume is generally more important than the cost per pound. Ease of fabrication is important and softening temperature should be high to increase the range of utility. A low molding temperature and high strength (tensile and impact properties) including high impact strength is desirable. Compressive strength is seldom of significance, but surface hardness should be as high as possible. While the index of refraction should preferably be high, complete absence of haze is of greater importance. Moisture absorption should be low, solubility in organic solvents should be a minimum and likewise liability to chemical attack. Odor and taste should be absent. Permanence of properties under prolonged exposure to light and to high temperatures as well as with simple aging, is important, particularly in such a use as safety-glass interlayer, where, however, some protection can be given by suitable selection of the composition of glass to be used.



Photos by Louis J. Venuto

Above—Some of the burner houses in which gas is burned to produce carbon black. Note the conveyor in the foreground. Left—Conveyor carrying carbon black from the sheds to the converter house

Bead Process Gives Clean Carbon Black

By CHARLES R. HAYNES

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FOR MANY YEARS the problem of dust control has been a serious one in the handling of carbon black. Particularly has this been true in the compounding of rubber for automobile tires, owing to the enormous quantities used for this purpose and to the fact that dry mixing is employed. Consequently, there have been many attempts to produce the black in a dustless form but until recently, none of these processes gave a product which combined truly dustless character with the maximum of dispersibility. Several years of investigation on the part of the companies with which the writer is associated led first to one suitable process, then to another even more satisfactory from an economic standpoint. Both processes* made possible the agglomeration of carbon black into tiny beads of uniform size, strong enough to prevent dust formation in handling and shipping, yet almost as readily dispersed as the unagglomerated product. The bead form has the incidental advantage of permitting gravity conveying, and of facilitating accurate weighing.

Carbon black has been definitely established as a pre-eminent example of a solid product which is separable into particles of colloidal size. These infinitesimal units are well below the resolving power of the ultra microscope, and are estimated to be even less in size than molecules of polymerized rubber. Since the mass of any one particle of carbon black is extremely small compared with its surface area or its cross-section, it is easily moved by the lightest current of air, and once afloat reacts but slowly to the pull of gravity.

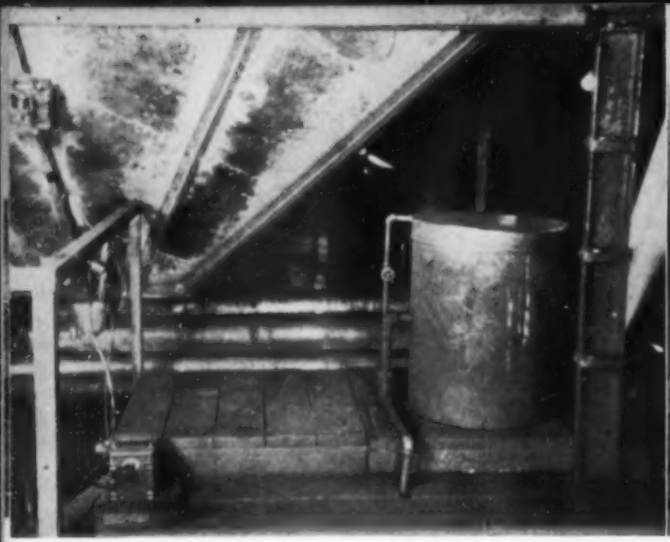
In the earlier days of the industry when carbon black was used chiefly in wet mixtures, as in paint and ink, dust was a nuisance but not so serious a problem as the bulkiness of the material and its consequent high handling and shipping costs. Carbon black has a theoretical density of 112 lb. per cu. ft., whereas, as scraped from the reciprocating structural steel channels in the burner house, its weight is not more than 3 lb. per cu. ft. Ordinary handling and packaging increase the apparent density to about 13 lb. per cu. ft. and by heavy hydraulic compression of the black in paper bags, a cubic foot volume can be made to hold up to 25 lb. Carbon black so compressed is commercially practical and is used in large quantities.

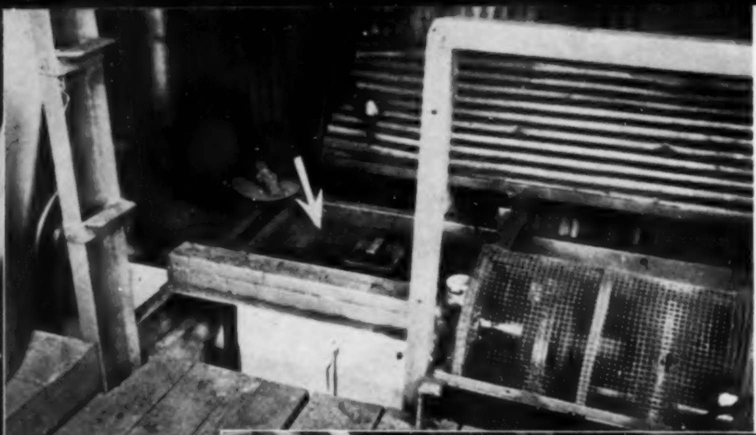
Dust Nuisance in Tire Factories

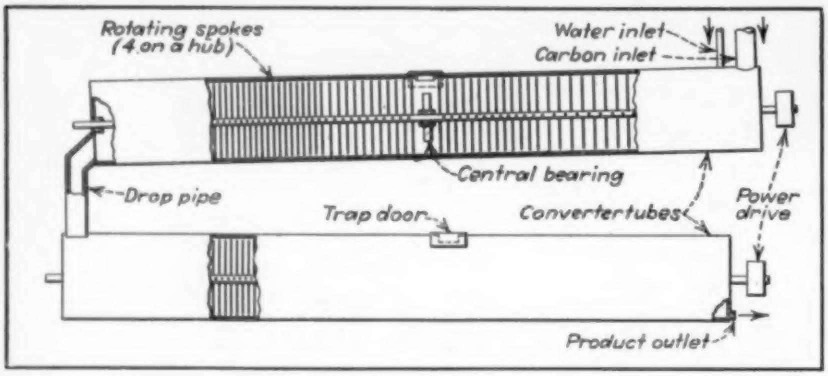
Good dispersion of heavy compressed black into rubber is easily obtained but, owing to the fact that it is mixed dry, there is a considerable amount of the material lost as dust. Further compression reduces the tendency of the black to fly but makes it hard to disperse, and since the reinforcing power of carbon black is a function of its dispersion, tire treads mixed with this too solid black do not deliver the mileage inherently possible in such a compound. These considerations, then, led directly to the development about to be described.

In general, when it is necessary to reduce the tendency of fine particles to fly, the commonly used procedure is to agglomerate them by introducing a binding material dissolved in a volatile solvent. With carbon black, however, this is impractical: first, because of the large amount of such binder that must be added to cover the extensive surface of the particles; second, because the black thus

*U. S. Patent 1,889,427, 1932, W. B. Wiegand and L. J. Venuto.
U. S. Patent 2,065,371, 1936, H. J. Glaxner.







Top Left—Crude carbon black storage bin, screw conveyor and water feed tank. Top Right—Arrow indicates feed end of converter. Power drive under screen at the right. Right—Rotary hot air dryer for drying pellets. Above—Diagram of two-stage pelletizing unit or converter

agglomerated is difficult to disperse since the particles adhere to one another after drying; and third; because the rubber manufacturer prefers raw materials unadulterated, in order that he may do his own compounding.

The simple addition of water to the carbon black in sufficient quantity to form a slurry and subsequent evaporation of the water from this paste leaves the black in a harsh condition not easy to disperse and in irregular fragments which may revert to dust during transportation.

Experiments showed that black, wet with water, could be compacted into spherical pellet form by adding a comparatively small amount of gasoline or similar volatile liquid immiscible with water, and agitating the mass. The gasoline displaced the water and was easily expelled by drying at low temperature, leaving pellets of soft texture, uniform size, and good dispersing qualities. This method lacked, however, the primary requisite of economy of operation, so further experiments were prosecuted.

One important result of the two-liquid method just mentioned was to show that beads could be formed under proper conditions of agitation even when the processing liquid was present in proportion far below that necessary to form a continuous phase or free meniscus. Acting on this lead, the final simplification was attained by the use of water alone, in comparatively small quantities with careful control of the type and duration of agitation and the conditions of drying.

Through regulation of the quantity of water used and the agitation, it is possible to govern the size of the spherical pellets formed and insure their uniformity. A typical Micronex bead has a diameter of 0.026 inch and consists of a thin, friable skin of relatively firm texture, inclosing a porous interior of loosely piled particles of carbon black which, when the skin has been ruptured, are easily dispersed in compounding with rubber. Numerous experiments have indicated that the particle size of carbon black of the type used in rubber manufacture is of the general order of magnitude of 65 millimicrons. The bead diameter, being some 10,000 times larger, has a volume equal to a trillion particles, but for various reasons this theoretical figure is probably not approached. There are, probably, several hundred billion individual particles in each bead. The remaining volume consists of air which has replaced the evaporated moisture. In this form carbon black bulks 27 lb. per cu. ft., with an air content of about two-thirds.

Producing Carbon Beads

At the bead making house the black is delivered by means of a screw conveyor and rotary fan to a tank in the top of the building. From this tank the black emerges in controlled flow to a second screw conveyor by which it is transported to the converter box where it is formed into beads. In the converter it is mixed with a carefully regulated supply of pure water, the amount of which approximates the weight of the fluffy black.

The converter is a long, narrow box of cypress wood, the construction of which is suggested in the drawing. Wood eliminates any possibility of rust contaminating the black and cypress is particularly resistant to moisture. The box is made in two levels. The black enters at one end of the top level, is gradually worked along to a baffle plate at the end over which it falls into the lower level. Here it is impelled in the opposite direction, finally passing over a second baffle into a chute leading to the dryer.

During the passage through the converter the black undergoes physical change as a result of its mixture with water and the impacting action of numerous pins on rotating shafts. These pins are 0.5-in. rods of stainless steel, set close together on a shaft of similar material. Since these shafts rotate at little more than 100 r.p.m., the speed through the black of the outer end of each pin is only a matter of 9 ft. a second—scarcely more than the rate of a brisk walk!

The first effect of this stirring is to mix the black and water into a thick paste and to keep the paste in a constant state of agitation by innumerable impacts of the pins. Each particle of the moist mass is hit and rolled to and fro in a sea of agitated fragments. Gradually the particles assume a rounded contour because of the agitation, and the semi-fluid mass is leveled out, its excess flowing over the baffle into the lower compartment in sufficient volume to equal the influx of dry black and water. The process in the lower stage is similar to the upper. More impacts by the steel spines, more agitation and rolling brings the fragments to the outlet as well defined pellets of uniform size and consistency. These pellets contain, however, 50 per cent of water and lose their shape easily under slight pressure.

After forming, the pellets are chuted to a gas-fired dryer, a steel cylinder 30 ft. long and 6 ft. in diameter, pitched at an angle of about 8 deg. to the horizontal. Through this the pellets gradually progress as the drum rotates. A current of warm air enters at the dry end, passes over the beads, and out again at the upper wet end. Numerous gas jets under the dryer raise the temperature to approximately 150 deg. F. In this gentle heat the moisture is gradually extracted to less than 1 per cent. Meanwhile the constant rolling of the beads over each other and on the inner surface of the drum completes the formation of the pellets, at the same time causing the surface to take on a slightly greater density. A simple calculation will show that every pellet in its helical path through the dryer rolls a distance of 3,000 ft., gaining on its goal about 2 in. at each revolution of the big drum. During drying the beads shrink slightly.

When the beads reach the end of the dryer they drop into a conveyor which takes them to the final operation. This is a sifting process which removes any agglomerate failing to pass a 20 mesh sieve. The small percentage of material rejected automatically feeds back into the bead box and is broken again into small fragments by the pins and is re-agglomerated.

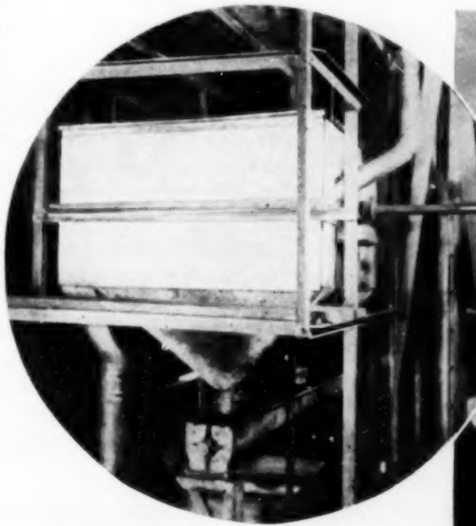
Undersize particles and loose dust are practically nonexistent at this point, making it unnecessary to subject the beads to further treatment or testing. They are weighed in an automatic hopper which, when filled, dumps its contents into a conveyor leading to storage houses and overhead tanks from which shipment may be accomplished either in packages or in bulk.

Close Laboratory Control

Although the process of making carbon black beads is entirely automatic from the moment the loose black enters the bead house until it leaves as a finished product, close supervision and laboratory control must be exercised at every stage. Frequent inspections are made of the condition and appearance of the black in the converter box, the relation of moisture to black being regulated as required. A second inspection is given the pellets as they leave the box and enter the dryer. The tests on the finished beads are frequent and searching. Every 20 minutes of the 24-hr. day a sample of the dryed beads is analyzed for moisture and, based on this test, the amount of gas burned under the dryer is regulated to retain the normal condition.

At less frequent but regular intervals samples of the beads are tested for rate of flow, bulking weight, grit, absorption properties and volatile content. Similar samples are tested by mixing into rubber compounds to determine their rate of cure and reinforcing values. Consistently uniform results in these tests are necessary in assuring the tire manufacturer the dispersion, reinforcement, and absence of dust that he demands.

Circle — Rotary sieve for finished pellets. Those too large are returned to the converter. Right—Converter house at left with conveyer above, carrying product to packaging house (center) and hopper-car loader at right



Sprayed Metal

Spraying corrosion resistant metals over equipment protects it from further attack

By B. L. BAILIE
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PEORIA, ILL.

EQUIPMENT that is scrapped each year because of corrosion and wear represents a staggering amount of money. In the progress of industry, the increased rate of production and the new conditions encountered have placed the physical equipment of industry under a severe strain. High speeds, high temperatures, high pressures, and new products have all helped to increase the annual toll taken by wear and corrosion. On the other hand, the development of new alloys has done a great deal to minimize the cost that industry is paying for its progress. However, the cost of many of the metals and alloys is so great that it has been found cheaper in many cases to replace the equipment than to buy equipment constructed of materials that will stand up under these new conditions. Every plant engineer is anxious to reduce his cost of maintenance and replacement, and the sprayed metal process has given him an opportunity to do just that.

Metal spraying, while in use before the World War, is only now being recognized as an important advancement in industrial technic. By using this process, a metal unable to withstand a certain corrosive may be given a coating of another metal that will withstand the chemical, and thus protect the base metal of which the equipment is built. Parts subjected to conditions which cause excessive wear may be built up to their original size and thus eliminate the necessity of purchasing new parts.

The process is simple, and outside of the initial cost of the metal spraying equipment, the cost is low. Too much emphasis cannot be placed on the first step, as the success of the entire process is dependent upon the proper preparation of the metal surface to which the coating is to be applied. All old paint, grease, rust or scale must be carefully removed. This is usually done by sand or grit-blasting although spindle pieces are sometimes placed in a lathe and rough-turned. After the piece has been cleaned, care must be taken to keep it free of finger marks, grease and dirt. Unless the piece is properly cleaned and these precautions observed, the sprayed metal coating will scale and chip off.

The piece is now ready to have a coating applied to the cleaned surface. The metal to be sprayed is usually in the form of wire, in sizes ranging from 18 to 10 gage B.&S. With some metals it is possible to use rods up to $\frac{1}{8}$ inch, however there is no advantage to be gained by using rods and in certain cases they are not as convenient to use. The sprayed metal coating is applied with an instrument shaped like a gun, and known as a gun. The wire feeding mechanism of the gun is driven by a small air turbine, and is so constructed that by a few simple gear changes the rate of feed may be changed to suit the requirements of the metal being used. The wire or rod is fed by the mechanism of the gun, into a cone flame and reduced to molten state. In this condition the metal is picked up by an air blast surrounding the cone flame and atomized. This atomized stream of molten metal is traveling at a high velocity through a blast of air at normal temperature, and as a result is cooled under the pressure of the air stream. The small particles of metal, now in a semi-molten state as a result of cooling in the air stream, and traveling at a high velocity, strike the surface of the base metal with sufficient force and at a temperature such that they adhere to the surface and form a coating upon it. This process continues until the metal coating reaches the desired thickness.

It has been determined that the bond between the surface of the base and the coating is purely mechanical, and in no way similar to the fusion bond associated with welding. Under the microscope the sprayed metal coating has been found to be a highly crystalline structure, the size of the crystal varying with the degree of atomization attained with the gun. The coating has a density somewhat less than the metal itself due to this crystalline structure and the mechanical bond between crystals. The compressive strength of the sprayed metal is higher, the tensile strength is lower, and the brinell hardness is about 35 per cent higher than that of the particular metal used. This increase in hardness is due to the air quenching and the crystalline structure of the sprayed metal. Fatigue tests show that the sprayed metal cannot withstand repeated reversals of stresses and strains. The reason for this is undoubtedly the mechanical bond and resulting lowered tensile strength.

Where coatings are applied to cylindrical or convex

Reduces Maintenance Costs

surfaces, the bond between the base metal and the coating is a great deal stronger than where the coatings are applied to flat surfaces. As a metal is spun onto the cylindrical surface it forms a sleeve of metal about the cylinder, which in cooling shrinks onto the cylinder of base metal. Thus there is little chance of scaling or chipping. The reverse condition is true of concave surfaces, particularly where the radius of curvature is small. Unless the base metal is preheated to a pre-determined temperature, and this temperature maintained throughout the process, upon cooling the coating will shrink away from the base metal. To do such a job successfully consideration must be given to the coefficients of the metals to be handled.

Sprayed metal surfaces may be machined, ground, and polished if so desired. By so doing, the tendency is to close the pores of the metal and produce a more dense wearing surface. One thing in connection with grinding and polishing that should be remembered is that the sprayed metal coating is a crystaline structure and harder than the metal in cast or drawn form. Grinding and polishing wheels recommended for use on the metal, whether cast or drawn, are not satisfactory for use on sprayed coatings of the metal. Special wheels must be used for this work. The same is true of polishing compounds when used on sprayed metal coatings.

It was at first thought that only the softer metals such as lead, tin, zinc, and aluminum were suitable for spraying. Today it is possible to use not only these soft metals, but also copper, bronze, steel, stainless steel, iron, nickel, and Monel. This has broadened the field of spraying to such an extent that it is finding wide use as a method of combating corrosion and abrasion. Equipment made of inexpensive materials may be given a coating of the proper corrosion resistant metal at a fraction of the cost of equipment made of corrosion resistant metal. Worn parts may be built up and once more put into service thus saving large expenditures for new equipment. Processes may be changed without undue loss from increased corrosion and abrasion. These are just some of the advantages of spraying metals.

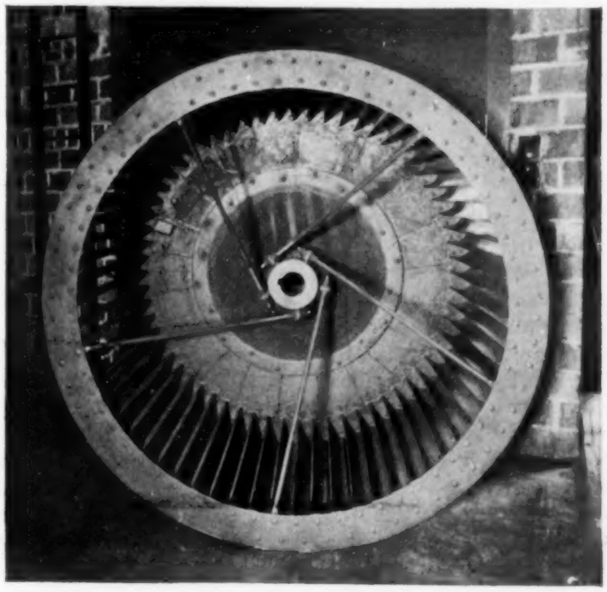
The rate of application of sprayed metal coating is dependent upon a number of factors such as specific gravity, specific heat, melting point and hardness. The chart on page 192 shows the rates at which the various metals may be applied to large surfaces. The figures given are for the average operator and are for the finest quality of coating. The rate may be increased from 10—25 per cent if a coarse grained coating is desired. For small parts such as shafts, valves and other small parts there will be a large variation from the figures given in the chart. There are also two other sets of pressures that may be used, these are as follows:

Acetylene	Oxygen	Air	Rate
20 lb. sq.in.	22 lb. sq.in.	80 lb. sq.in.	13% less than chart
15 lb. sq.in.	17 lb. sq.in.	80 lb. sq.in.	25% less than chart

You will note that the air pressure is the same in all three cases. By maintaining the same air pressure the same degree of atomization is obtained and thus the quality of the coating is the same. Any variation of the air pressure varies the degree of atomization and thus results in a variation of the fineness of the coating. Variation of the air pressure is only possible inside a limited range which will vary to a certain extent depending upon the metal being sprayed.

Sprayed metal coatings have been used for various types of application in the Hiram Walker distillery. Varying degrees of success have been experienced, but in most every case where the proper metal was properly applied the results have been gratifying. The inside surfaces of steel tanks used for processing and storage of grain alcohol and gin have been successfully coated with tin. After a coating of the proper thickness had been applied to these tanks, the surface of the coating was brushed and rubbed to produce a dense solid surface film. Tanks treated in this manner have been in use for over two years without showing any signs of failure. At the present time a test is being conducted to determine which of several metal coatings should be used to protect the inner surface of the steel syrup tanks used in the distillery

Fan wheel protected from corrosive fumes by a stainless metal sprayed over the base metal



feed house. This surface is subjected to the corrosive action of lactic acid and other organic acids.

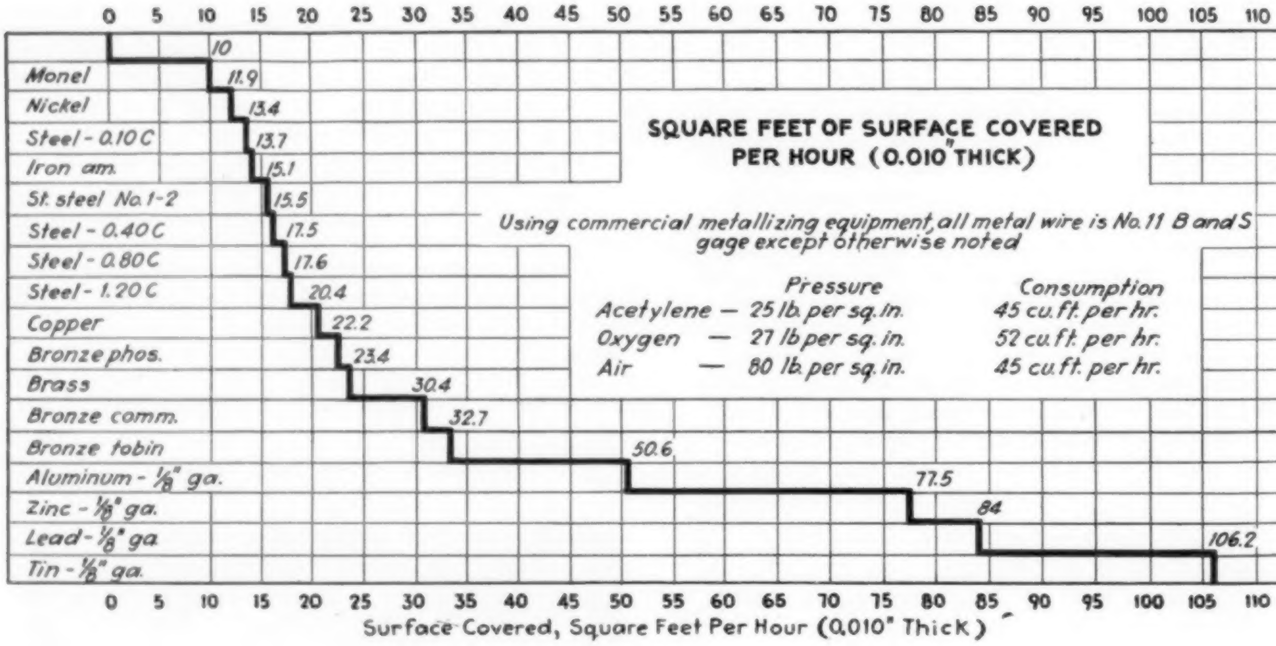
Pump casings and impellers have been sprayed to prevent corrosion. Pump shafts have been successfully rough-cut and built up by metal spraying with stainless steel. Pump shafts after being built up are finished on the grinding machine and often a better shaft results.

The large plugs in six inch and eight inch plug cocks that are used in meal and mash lines become wiredrawn and worn through the action of high-pressure steam and finely ground meal. These plugs have been satisfactorily resurfaced in our shop by using this process. The plugs are first rough-cut in the lathe and then given a coating of metal. It was necessary to do a bit of experimental work with these plugs to determine the proper metal to use. Due to different coefficients of expansion, the same metal that is used in the body of the valve cannot be used. It was found to be cheaper to use a softer metal and provide for the natural wear than to "freeze" the plug to the body of the valve. At the present time the choice lies between hard copper, which lasts about four months, and tobin bronze, which lasts about six months.

The casings and fan wheels of large centrifugal fans used to carry off the vapors from the huge rotary dryers in the distillery feed house were originally constructed of 5 per cent nickel steel. After being in use for six months the metal showed signs of being rapidly destroyed by corrosion and abrasion. The fan wheel was removed and successfully metalized, first, with tin to insure a good bonding surface, and then with stainless steel. The casing of the fan was lined with stainless steel.

At the present time the fan has not been back in service long enough to make any comparisons. However, all indications are that the sprayed coating will greatly increase the length of the period of usefulness of this piece of equipment.

Many other industries have found similar uses for metal spray, and the writer is convinced that all plant engineers should avail themselves of the opportunity of reducing maintenance and replacement costs that is afforded by this process. Surfaces being attacked by corrosion should be covered with the metal as soon as the corrosive action is discovered. By using the proper corrosion resistant metal the life of the equipment may be increased many times. Save the surface and you save the machine.



As the author has mentioned there are numerous applications for metallizing in the other process industries. In the petroleum refinery it is used for spraying aluminum to prevent corrosion on heat exchangers, flash chambers, dephlegmaters, and for protection against heat and corrosion in burner caps, burner pipes, furnace parts, etc. Pressure towers and storage tanks are also covered with a protective covering of aluminum by this method.

The pulp and paper industry uses the metallizing process for coating rolls with brass, for coating pipe rolls, for coating cast iron rolls with stainless steel; for covering beaters, digesters, and washers with cadmium. The perforated plates in cell covers in the bleach plant are covered with stainless steel by this method.

Rayon producers coat tanks with zinc and tin by spraying. The textile manufacturer coats starch mixers with zinc, size kettles with tin and copper, dye kettles and jog boxes with nickel silver, sulphuric acid wash tanks with lead and dye cans with tin.

One company had a very severe corrosion problem in steel plate bins containing diatomaceous earth with a trace of salt present. These bins were metallized with lead and a test of over a year in actual service showed that the corrosion trouble in the steel bins had been fully overcome.

These examples will serve to give some idea of the widespread use in the process industries for this method of protection against corrosion and wear.—*Editor.*

Process Developments at T.V.A. Phosphoric Acid Plant

By H. A. CURTIS, A. M. MILLER and R. H. NEWTON

A description of the two phosphoric acid plants as originally built and operated by T.V.A. at Wilson Dam was published in *Chem. & Met.* in June, 1935.[1] Both of these plants have been modified from time to time, either to eliminate some operating difficulty or to try a new method. Now, a third acid plant has been built. The features of the new No. 3 unit and some of the changes which have been made in plants No. 1 and No. 2 are described in the present article. — Editor.

EACH OF T.V.A.'s three phosphoric acid plants, along with their corresponding phosphorus condensing plants, have been numbered to agree with the electric furnaces normally serving them, i.e., No. 1, No. 2, and No. 3. Each complete unit is designed to process somewhat more than the amount of phosphorus liberated by an electric smelting furnace using 5,300 kw.

In Acid Plant No. 1, as originally built, the gases from Electric Furnace No. 1 were piped to the top of a tall tower and were delivered into the tower by a fan. The gases were burned in the upper part of this tower, cooled somewhat with excess air, the P_2O_5 hydrated in the lower part of the tower, and the phosphoric acid recovered partly at the foot of the tower and partly in a Cottrell electrical precipitator adjacent to the tower. The long pipe from the furnace offtake to the fan at the top of the burner-hydrator carried automatic pressure control dampers, and the fan speed was regulated automatically.

Once the furnace offtake gases had been delivered into the burner-hydrator, the remainder of the system worked fairly well. But the hope that the unburned gases from the furnace could be delivered to the burner-hydrator through a long pipe, control dampers, fan, etc., appears ludicrous in the light of present knowledge. The pipe line promptly became plugged with a mixture of gummy metaphosphoric acid, elemental phosphorus and dirt. All dampers, fans, by-passes, and other obstructions in the line had to be removed and means provided for routine cleaning of the line. The plant was thereafter operated successfully for seven months, and several thousand tons of phosphoric acid were produced. At the end of this period the vertical burner shown in Fig. 2 was built, and the plant again operated for several months.

Meanwhile, it had been decided to try the scheme of condensing elemental phosphorus from the furnace offtake gases, recovering the carbon monoxide as fuel gas, and burning the elemental phosphorus in a vertical burner. It was thought at first that the value of the recovered carbon monoxide and other advantages would justify the cost of recovery. By the time the phosphorus condensing and burning plants had been designed, however, it became evident that no economy was to be expected from the scheme. It was then decided to build the condensing and burning plants for other reasons than economy. One reason was that the national defense value of the plant would be increased by the facilities for producing elemental phosphorus. Also, it was desirable to gain experience in the condensing, storing, pumping, and metering of phosphorus. And finally, there was taken into account the fact that elemental phosphorus is the ultimate concentration in which phosphatic material can be shipped. Where freight may be prohibitively high on a phosphatic material carrying 16 per cent or even 45 per cent P_2O_5 equivalent, it may still be feasible to ship elemental phosphorus having a P_2O_5 equivalent of 229 per cent.

The phosphorus condensing system adopted is shown diagrammatically in Fig. 1. The phosphorus collected in the phosphorus storage tank is eventually pumped to one of the acid plants and converted to phosphoric acid.

The phosphorus condensing plant shown in Fig. 1, and its attendant acid plant shown in Fig. 2, were put into operation in January, 1936, and are still in use (December, 1937), although numerous small changes have been made in them. The carbon monoxide is used in place of oil in the nodulizing kiln mentioned earlier. The phosphorus condensing plant is a troublesome and dangerous one to operate. It does collect daily about nine tons of elemental phosphorus, and therefore represents a logical adjunct to Nitrate Plant No. 2 as a national defense asset. From the standpoint of fertilizer production at Wilson Dam, however, the cost of recovering carbon monoxide is more than this fuel gas is worth. As mentioned above, there is a real argument for producing elemental phosphorus if it is desired to ship phosphorus as such to a distant point. The Monsanto Chemical Co. is at present shipping elemental phosphorus in tank car lots from Tennessee to its plant at Anniston, Ala. and it would appear that shipment of elemental phosphorus will eventually be a factor in utilization of the great western deposits of rock phosphate.

The phosphorus condensing system shown in Fig. 1 is a totally enclosed system. The design of a phosphorus condensing plant may be much simplified if it be assumed that water which has been in contact with phosphorus may be exposed in open tanks or may be discarded from the system. The health hazard in such a plant is not known, however, and in the plant here shown a closed system was assumed to be necessary.

It appears worth while to recount some of the diffi-

culties encountered in the operation of the plant, particularly because some of these arose in unexpected ways, and others, although not unexpected, proved to be worse than anticipated.

In the early months of operation, plugs in the liquor circulating system caused continual trouble. The material causing most of the plugging was identified as needle-shaped crystals of potassium fluosilicate. These grew on pipe walls, pump casings, etc., and not only hindered flow, but also served as a framework in which gelatinous silica, phosphorus and dirt became entangled, until eventually the liquor flow was entirely cut off. Obviously, the frequent opening and cleaning of the liquor circulation system was both troublesome and dangerous. The difficulty caused by potassium fluosilicate was eventually reduced to tolerable limits by making the Dorr thickener the coldest point in the liquor system. By this means the liquor in other parts of the system was kept unsaturated with respect to potassium fluosilicate. The fluosilicate was removed from the system along with the phosphorus and phosphorus bearing sludge, which were pumped to the burner shown in Fig. 2.

The sludge mentioned above is a constant source of trouble in the condensing plant and in the acid plant. In fact, sludge so interferes with the operation of these plants that only certain kinds of phosphatic materials may be used in the electric furnaces if the phosphorus therefrom is to be recovered and subsequently burned without further purification.

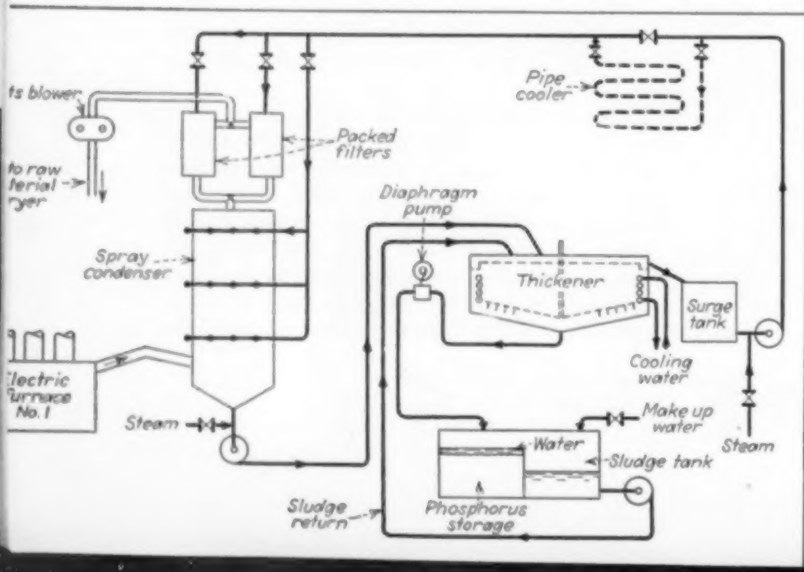
Sludge, as encountered in the phosphorus condensing system and phosphorus storage tanks, is a mixture of water, gelatinous silica, potassium fluosilicate, dust particles carried over from the furnace, and phosphorus. Its consistency may vary from that of a thin soup to a gel so thick that it will not flow into the suction line of a centrifugal pump even at 200 deg. F. The phosphorus content of the sludge varies considerably and, under unfavorable conditions, all the phosphorus volatilized from the furnace may be suspended in the sludge. A part of the phosphorus collected may settle out of the sludge, and more may be separated by heating the sludge, although no amount of heating or other simple known treatment will completely separate the phosphorus. Filtering will yield a clean phosphorus, but is not cheaply accomplished and leaves a residue, the disposal of which is a problem.

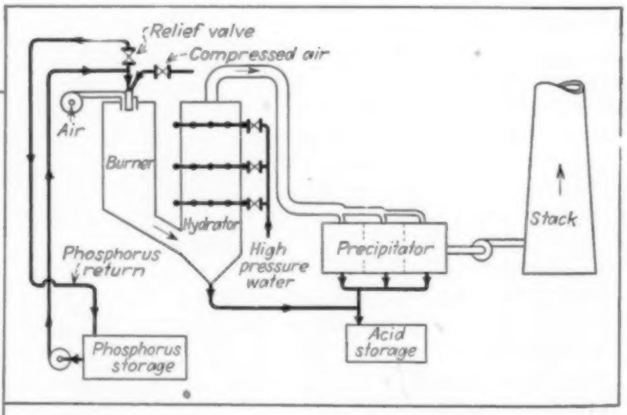
If the phosphorus is to be burned at the point of manufacture and converted to fertilizer, there is no advantage in separating the phosphorus from the sludge. It is then simpler and cheaper to let the sludge go along with the phosphorus to the burner or phosphorus vaporizer. The problem then reduces itself to that of keeping the concentration of phosphorus in the water-silica-fluosilicate-dirt-phosphorus mixture high enough to permit burning. The amount of water which can be thus handled along with the phosphorus depends, naturally, on the method of burning. This will be discussed later. For the present, it may be pointed out that, inasmuch as the rate of phosphorus production from a furnace is fairly constant for a given power input and a given P_2O_5 content in the furnace burden, the necessary procedure is to use a furnace burden that will not cause too high a rate of sludge formation in the phosphorus condensing system.

The relation of furnace charge to sludge formation is not a simple one. While dust from the charge does actually accumulate in the sludge, the principal components of the sludge, aside from water and phosphorus, are gelatinous silica and potassium fluosilicate. The fact that the silica appearing in the sludge is gelatinous indicates that it probably has been formed by reaction between silicon tetrafluoride in the furnace gas and the water in the phosphorus condensing system. Such a reaction would also account for fluosilicate found as potassium fluosilicate in the sludge. Inasmuch as the compounds from which these two materials originate are both carried out of the furnace as gases, (the potassium may be in the form of a fume of the oxide or halide) filtering the furnace gas or the use of a precipitator would not eliminate the sludge problem if water were subsequently brought into contact with the gases in the condenser system.

The best phosphatic material so far tried in the electric furnace, so far as lessening the sludge problem is concerned, is washed phosphate sand, well nodulized and subsequently screened to remove the particles passing a 4-mesh screen. This material is not only relatively free from dust, but also carries less fluorine than washed sand, or lump phosphate.

When sintered phosphate muck is used in the electric





Figs. 1 & 2—Flow diagrams of phosphorus condensing plant No. 1 and acid plant No. 1. This unit and the No. 3 unit condense the phosphorus before burning it to P_2O_5, while the No. 2 unit burns the phosphorus-laden electric furnace gases directly. A material balance over No. 1 and No. 3 showed that of the total P_2O_5 in the raw phosphate processed, 87.6 per cent was recovered in salable form as available P_2O_5 in superphosphate or as phosphorus in recovered ferrophos. This compares with 92 per cent overall recovery of P_2O_5 in the No. 2 unit

furnaces, it is also necessary to screen out the particles passing a 4-mesh screen, and even then there is much sludge formed in the condenser system. The amount of sludge formed is in some way related to the alumina carried in the muck from which the sinter is made, the upper limit for the alumina being about 8 per cent if sludge formation is to be kept low enough to permit plant operation. Inasmuch as the potassium content of the muck is largely associated with the alumina, and potassium fluosilicate is one of the chief components of sludge, the difficulty noted in using high-alumina sinter may be due to the associated potassium. It is noted, however, that when a high alumina material of any sort is used in the furnaces there is more alumina than usual in the gas.

The phosphorus condensing plant shown in Fig. 1 does not remove the phosphorus from the furnace gas as completely as had been anticipated. The reason for this lies in the fact that the scrubber tower following the condenser has to be operated at a higher temperature than planned. Recently an indirect, air-cooled condenser has been installed between the tower and the gas pump. This increases the phosphorus recovery somewhat.

It was anticipated in the design of Acid Plant No. 1 that the circulating liquor in the condensing system would become acid, due to practical impossibility of entirely preventing leakage of air into the electric furnace and consequent burning of a small proportion of the phosphorus. The system was therefore made of acid resisting materials. In operation it has been found that the circulating liquor carries from 5 to 15 per cent phosphoric acid. The average of 24 samples taken in November, 1937, was 8.1 per cent H_3PO_4. Brass pipe and fittings, and bronze pumps are sufficiently acid resisting to handle the circulating liquor. The Roots blower shown in Fig. 1 was originally an ordinary cast iron blower. It was necessary, however, to resurface the rotor and the casing walls with bronze after the blower had been in use a short time, and eventually the blower must be replaced with an all-bronze one.

Present Acid Plant No. 1 is shown diagrammatically in Fig. 2. Phosphorus is circulated through a loop of steam heated pipe from the storage tank shown in Fig. 1 to the top of the vertical burner shown in Fig. 2 and thence back to the storage tank. The phosphorus to be burned is drawn out of the circulation system at the top of the loop and admitted to the vertical tower through an atomizing burner.

This acid plant operates fairly well so long as sludge carrying 70 per cent or more of phosphorus is used. With a lower proportion of phosphorus it is not possible to keep the burner in steady operation. Unburned phosphorus is distributed throughout the acid plant and the superphosphate plant, the phosphorus particles burning from time to time along the way, some of them finally burning in the superphosphate storage pile. To eliminate this occasional trouble and to permit the easier handling of phosphorus bearing sludge, a vaporizer such as used in Acid Plant No. 3 is now being installed ahead of the vertical burner.

The furnace gas from Electric Furnace No. 2 is burned in a horizontal combustion chamber immediately after leaving the furnace, the resulting P_2O_5 is hydrated, and the mist laden gases are passed through an electrical precipitator and thence to the stack. Only minor changes have been made in this system since it was put into operation in November, 1934.

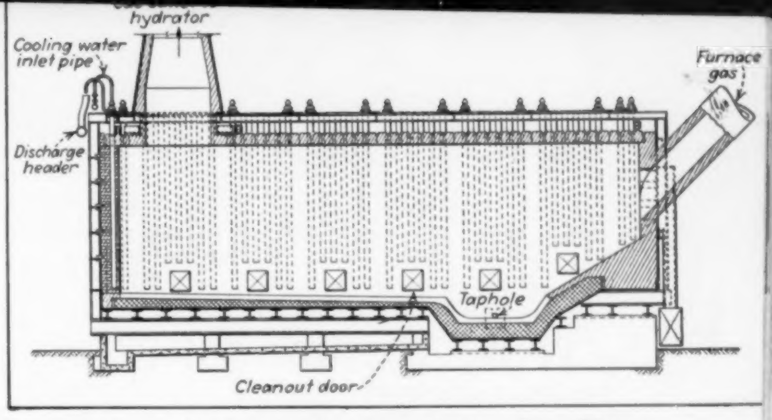


Fig. 3—New combustion chamber in which gases from Electric Furnace No. 2 are burned immediately after leaving the furnace. Copper cooling tubes are enclosed in the walls

Recently it became necessary to renew the combustion chamber. The original combustion chamber served to produce about 15,100 tons of P_2O_5. The chief maintenance item was replacement of the cooling tubes which were located inside the furnace along the walls. The removal of the viscous mixture of metaphosphoric acid, dust, etc., (called "gunk" by the operators) from the old combustion chamber was an awkward and time-consuming task.

The new combustion chamber, now in operation, is shown in Fig. 3. Copper cooling tubes have been placed within the walls of this furnace. They do not remove as much heat as did the tubes in the old furnace, but they should have a much longer life. The floor of the new combustion chamber has been sloped from each end down to a trough so that the gunk may be tapped out conveniently. The new combustion chamber has been in operation too short a period to reveal all the advantages or disadvantages it may have as compared with the combustion chamber originally installed.

Disposal of Combustion Product

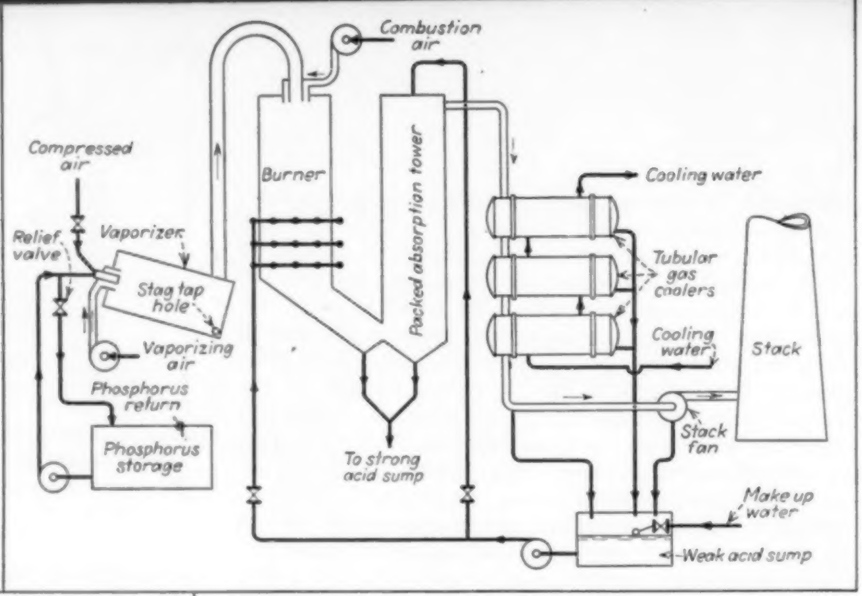
The plant operators recognize two varieties of gunk, one a liquid and the other a solid. The liquid is merely metaphosphoric acid, usually carrying a few per cent of impurities, principally lime and silica. The liquid gunk presents no disposal problem since it dissolves readily in water and rapidly hydrates to form the orthophosphoric acid.

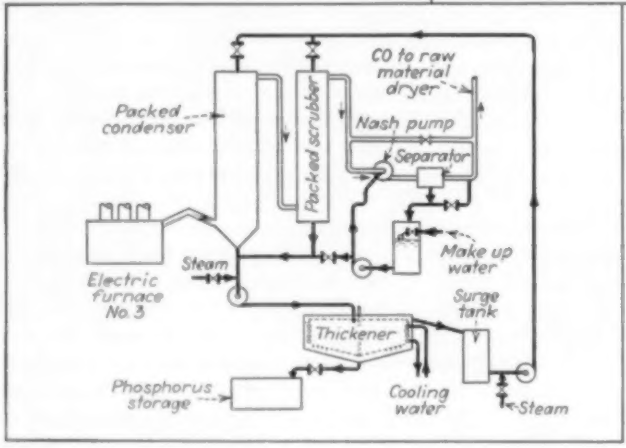
The solid gunk, which is tapped as a molten slag from the No. 2 combustion chamber, and from the vaporizer in the No. 3 Acid Plant, varies somewhat in composition when different charges are used in the electric furnaces, particularly in that it carries more alumina when a high alumina phosphatic material is used as furnace charge. The following are typical analyses:

P_2O_5	CaO	SiO_2	Al_2O_3	K_2O	F	*Remarks*
63.6	6.9	12.5	tr	tr	tr	From combustion chamber. Brown lump rock in furnaces.
60.1	4.8	10.8	0	8.4	0	From combustion chamber. Akin muck nodules in furnaces.
62.4	1.7	14.0	7.7	0	0	From vaporizer. Sinter in furnaces.
63.0	1.2	15.0	9.7	6.6	0	From vaporizer. Akin muck nodules in furnaces.
60.6	1.7	20.8	0	3.1	0	From vaporizer. Nodulized sand in furnaces.

This solid gunk is a glassy material. In lump form it shows almost no solubility on treating for 24 hours at 100 deg. C. with water, phosphoric acid, or sulphuric acid. On grinding with water for six hours, a part of the P_2O_5 goes into solution. It is evident that it is not practical to dissolve the solid gunk and hydrate it, as may be done with the liquid gunk. On fusion with soda

Fig. 4 & 5—Flow diagrams of new phosphorus condensing plant No. 3 (below) and acid plant No. 3 (right). The changes incorporated in this new unit will be apparent if the diagrams are compared with those in Figs. 1 & 2





ash the P_2O_5 in the gunk becomes completely available.

Two practical methods have now been developed for handling solid gunk. If ground limestone be fed to the combustion chamber, the gunk may be tapped out as a calcium metaphosphate in which the P_2O_5 is nearly all in available form. Also, if the solid gunk be added to the rock charged to a metaphosphate tower, the gunk fluxes with the metaphosphate formed and the P_2O_5 then becomes available.

The Cottrell electrical precipitators used in Acid Plants No. 1 and No. 2 have given satisfactory service. Several changes in materials of construction have been made since the precipitators were put into service three years ago. The major changes have been to replace lead with acidproof masonry, and to replace the silver electrode wires with stainless steel wires.

Numerous performance tests have been made on the precipitators indicating that they normally remove more than 98 per cent of the suspended acid particles. It has been found, however, that electrical precipitators are not at all necessary in order to recover practically all of the phosphoric acid. Whether electrical precipitators should be used or other equally effective equipment is a matter of engineering economics.

Changes in New Unit

Phosphorus Condensing Plant No. 3 is shown diagrammatically in Fig. 4. It does not differ radically from Phosphorus Condensing Plant No. 1 shown in Fig. 1. A packed tower is used as the primary condenser in No. 3 as compared with the open spray tower in No. 1. A Nash "Hytor" pump has been substituted for the Roots blower used in the No. 1 unit. The sludge pump which handles the underflow from the Dorr Thickener of the No. 1 unit has been eliminated in the No. 3 unit, the sludge and phosphorus being allowed to flow by gravity into the phosphorus storage tank. The general arrangement of equipment as actually set up in the No. 3 unit is more convenient than in the No. 1 unit. The No. 3 unit has been in operation since July, 1937, and performs fairly satisfactorily. A phosphorus condensing system of this sort will, however, always be a more or less dangerous unit to operate, and, unless there be some special reason for collecting elemental phosphorus as such, there is no argument in favor of this arrangement as against the No. 2 system, where the electric furnace gas is burned immediately on leaving the furnace.

Acid Plant No. 3, as now set up, is shown diagrammatically in Fig. 5. Originally the phosphorus vaporizer was located at the top of the vertical burner. It was found that the vaporizer in this location was too dangerous and too inconvenient from an operating standpoint. Also, the particular vaporizer first tried would not operate with sludge of low phosphorus content. A new vaporizer, located at the foot of the vertical burner, as shown in Fig. 5, was therefore set up. Both the vaporizer and burner are water-cooled externally.

In operation, only sufficient air is admitted to the vaporizer to burn a part of the phosphorus. The water in the accompanying sludge is flash evaporated, and the solids of the sludge fused. The resulting slag is tapped out of the vaporizer from time to time.

There is no reason why the vaporizer and burner should not be combined into one unit and the gas therefrom cooled and passed directly into the packed tower.

A packed tower and tubular condenser have been substituted in this No. 3 unit for the hydrator and electrical precipitator used in the No. 1 unit. The acid recovery in the No. 3 unit is very high. In fact, the waste gas from Acid Plant No. 3 carries only about 4 per cent as much P_2O_5 as does the waste gas from Acid Plant No. 1.

As originally set up, the tower in the No. 3 acid unit was packed with carbon raschig rings in the lower section, and with clay raschig rings in the upper section. The clay rings promptly began dissolving in the acid, and an aluminum phosphate precipitated in the underlying carbon rings until the tower was finally plugged. The tower was then cleaned out and packed with coke in a bed 15 feet deep. Nearly all the acid is caught

in the packed tower, and only a very small proportion in the tubular condenser.

It is realized that the diagrammatic drawings of Figs. 1 to 5 give only a very inadequate idea of the actual design and construction of the several units discussed above. It is not feasible to include in the present article the actual engineering drawings and the descriptive text required to explain such drawings, or to discuss the results obtained in semi-works plants which were built and operated to develop information for the design of the larger units.

From Acid to Superphosphate

The plant constructed for the manufacture of concentrated superphosphate has been described in a previous article.[2] The plant has not been changed materially in the past three years. A number of mechanical improvements have been made in the Read mixers, and methods of reducing maintenance of these machines developed. The ground rock and acid are weighed in batches and dumped into the mixer bowl. The mixing cycle from batch to batch is held at about 2½ minutes. Each of the mixers in use will produce an average of 15 tons of superphosphate per hour. Many tests have been made to determine the optimum acid strength, the optimum screen analysis of the ground phosphate, the best ratio of phosphate to acid, etc.

The following data for the month of November, 1937, are typical of present practice:

Ground rock used	1,433	tons
Grade of ground rock	32.2%	P_2O_5
Screen size of ground rock	79.6%	through 200 mesh
Acid strength	78.3%	
Acid (78.3%) used	1,977	tons
Total P_2O_5 in superphosphate	48.7%	(before curing)
Available P_2O_5 in superphosphate	46.9%	
Free acid in superphosphate	3.2%	
Moisture in superphosphate	6.7%	

Acid of 78 per cent strength is not the acid which gives a maximum conversion of the phosphate in the ground rock to the available form. An acid of 70 per cent strength gives a maximum conversion,[3] but the superphosphate made with the more dilute acid requires more frequent cleaning of elevators, conveyors, chutes, etc.

The weight of acid now used per unit weight of ground rock (brown Tennessee rock) is 92 per cent of the calculated amount to convert all the CaO, P_2O_5, Fe_2O_3, and Al_2O_3 in the ground rock to monocalcium phosphate, ferric phosphate ($FePO_4$) and aluminum phosphate ($AlPO_4$). The 92 per cent factor is based on experiments undertaken to determine the most economic proportion of acid to be used under given conditions.

Superphosphate made from 78 per cent phosphoric acid and immediately piled in the storage building cures in about one month so far as decrease in citrate insoluble P_2O_5 is concerned. In big piles, however, the moisture retained at the end of one month's storage is still a little too high to permit easy disintegration and screening. At the end of three or four months the material may be handled easily.

Storage of Superphosphate

A storage test was carried out, using in one case the T.V.A. superphosphate made from concentrated (78 per cent) phosphoric acid and in the other a concentrated superphosphate made from dilute (50 per cent) acid by the wet method and artificially dried.

It was noted that the wet method product had a bulk density of 46 lb. per cubic foot, whereas the T.V.A. product had a bulk density of 65 lb. per cubic foot. One would naturally suppose that, other things being equal, the higher bulk density would be an advantage, inasmuch as the bag cost is less. It is well known, however, that farmers have been led to believe that a big bag of fertilizer must necessarily have more value than a smaller bag. Perhaps this is an argument for the use of the peanut shells and other rubbish often found in mixed fertilizers sold under fancy trade names.

In the comparative storage tests four different kinds of bags were used. In each case the bags were piled five deep. The samples were examined at the end of one month, three months, six months, and twelve months. So far as chemical analyses go, the two materials were equally satisfactory, although the wet method product, having been made from a higher grade rock, was a little higher in available P_2O_5.

Storage Test Results

In storage, two items are of particular importance, namely the tendency of the product to cake, and the tendency to rot the bags. At the end of the one month and three months periods, no great differences were noted in the two products. At the end of the six months, nine months, and twelve months periods, the wet method product was caked to a somewhat greater degree than the T.V.A. product. The bags containing the wet method product (even when "limed" with 200 pounds of lime per ton) were badly rotted at the end of six months' storage, whereas all bags carrying the T.V.A. product were in good condition at the end of the year in storage. The general conclusion is that superphosphate made by either the wet method or the electric furnace method may be stored in bags for three months without difficulties arising. For longer periods of storage the electric furnace product is somewhat superior so far as caking is concerned and very decidedly superior so far as rotting of bags is concerned.

The development of industrial processes and the design, construction, operation, and improvement of plants, are not accomplished by a few individuals, but by groups of workers. The present authors acknowledge the contributions to the results here recorded made by other members of the T.V.A. Chemical Engineering Department.

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Correction

In the article on T.V.A.'s experience in phosphate smelting, published in *Chem. & Met.* last month, the analysis of ferrophos given on page 120 should have shown 0.7 per cent *silicon* instead of *sulphur*.—Editor.

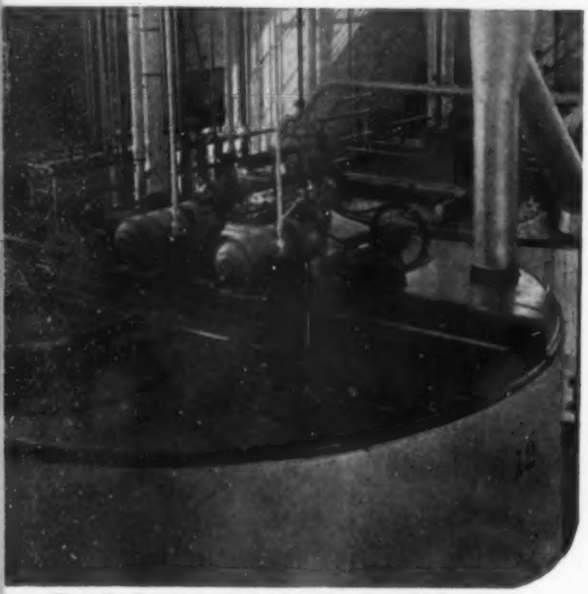


Fig. 2—Large reaction tanks in which the sulphur-caustic soda reaction takes place. Sodium polysulphide is fed from these tanks into the reactor shown in Fig. 4

Dow to Make THIOKOL

WITH THE END of April comes the official opening of the new plant unit of the Dow Chemical Co. at Midland, Mich., which is to make Thiokol, a rubber-like material for the Thiokol Corp. This arrangement is a considerable departure from the previous one in which the Dow Company supplied most of the raw materials and the Thiokol Corp. carried on the manufacturing operations in New Jersey. The new construction was necessary to fill two needs—increased capacity and increased efficiency. In addition to fulfilling these needs, it has the advantage of good location, being near the center of both raw material sources and consuming markets.

Although the process used in the new plant is essentially the same as that previously used at the Trenton,

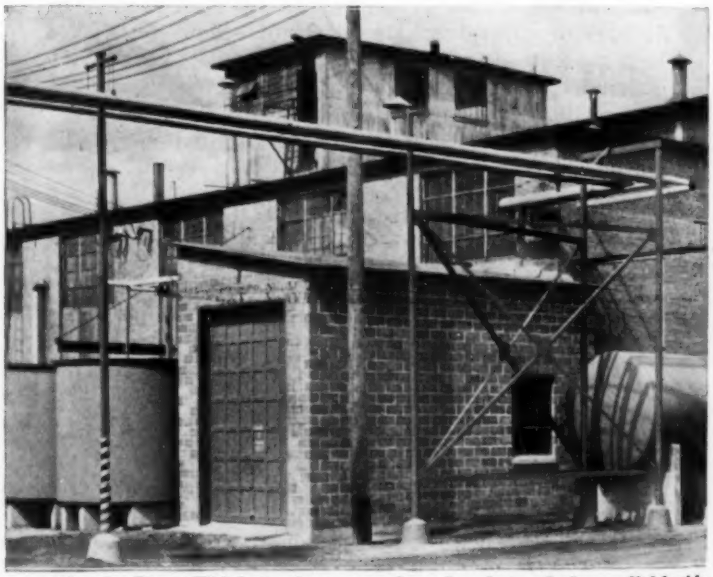


Fig. 1—Dow Thiokol plant exterior showing ethylene dichloride storage tanks at right and sodium polysulphide storage at left.

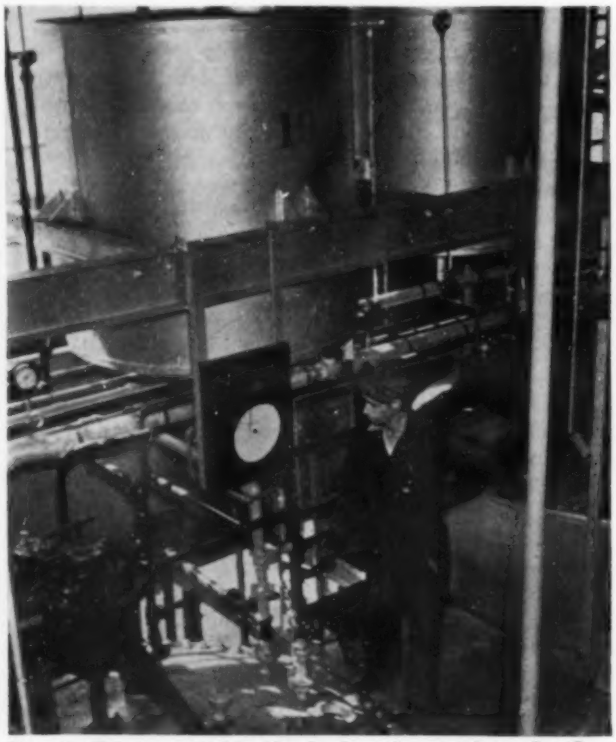


Fig. 3—Ethylene dichloride feed tanks regulate the flow of this liquid from storage to reactor. The compound is made from ethylene and sodium chloride

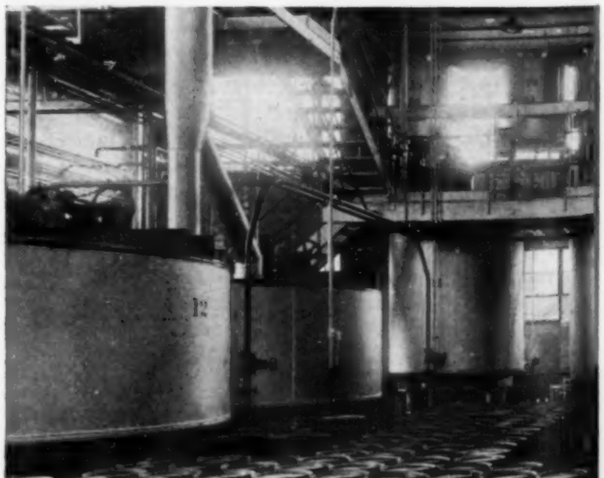


Fig. 8—In the convenient new flake form Thiokol lends itself to drum packing instead of the former awkward box

Fig. 4—Ethylene dichloride, sodium polysulphide, magnesium chloride and catalysts form liquid Thiokol latex in this reactor

in New Midland Plant

N. J., plant, a number of improvements have been made. Careful plant layout promotes efficiency. Mechanization of process evidenced by more automatic control equipment and less supervision has materially reduced processing time. Applied research on coagulation procedure has added technological improvements.

The plant has created a new form of product. Formerly emerging as large awkward sheets which had to be hand packed in boxes, the rubbery compound is now made in a form which is conveniently discharged into drums for shipping. A capacity of 1½ to 2 million lb. of the compound per year is said to be representative of normal operating conditions. Steps in the process are illustrated by the accompanying halftones of the first photographs to be released from the plant.

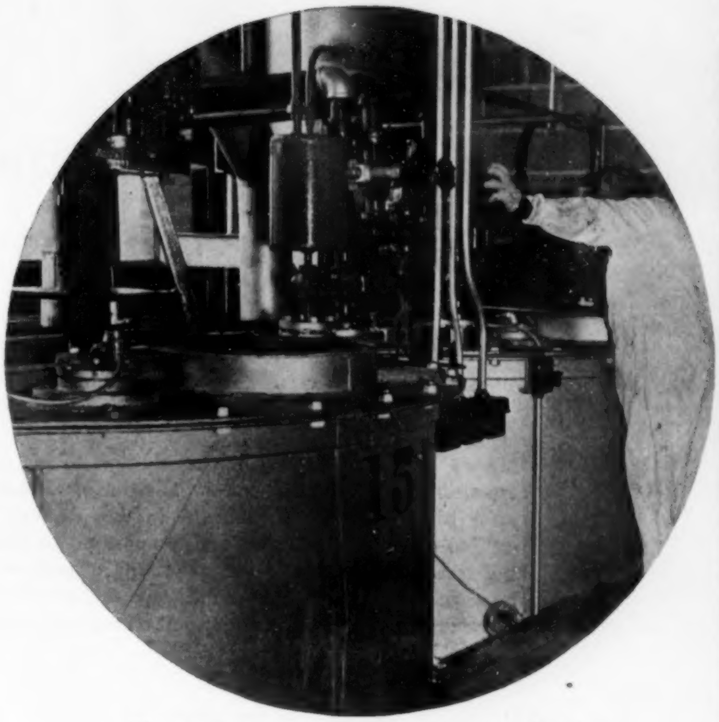
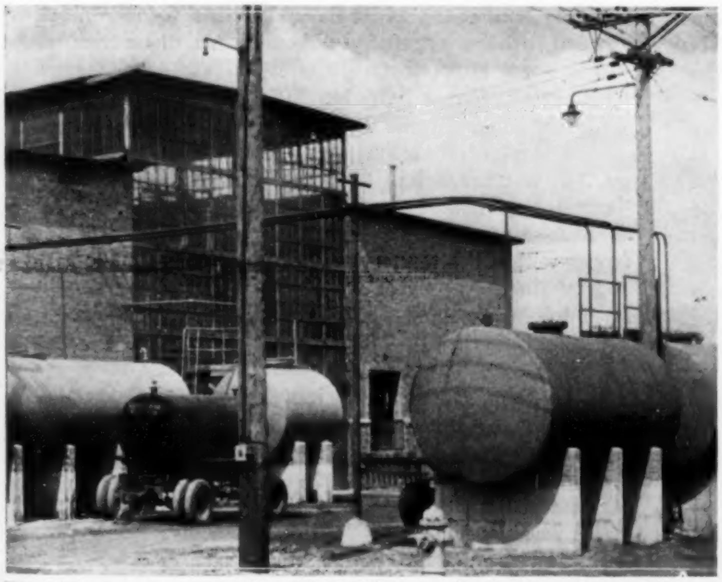
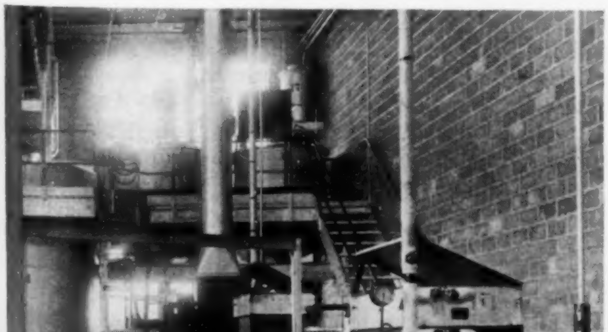


Fig. 5—From the reactors the liquid latex flows into these coagulators and is coagulated by the addition of acid. In a gummy, viscous mass it is then flushed out into washing tanks



The former raw material is supplied ready made while the latter is made on the premises from sulphur and caustic soda

Fig. 6—Here the agglomerated latex from the coagulators is washed and formed into flakes by a new process. Water is pressed out of the flakes by the rolls at the left



packing required for the sheet form. Time elapsed from raw materials to finished product is only 4 hours

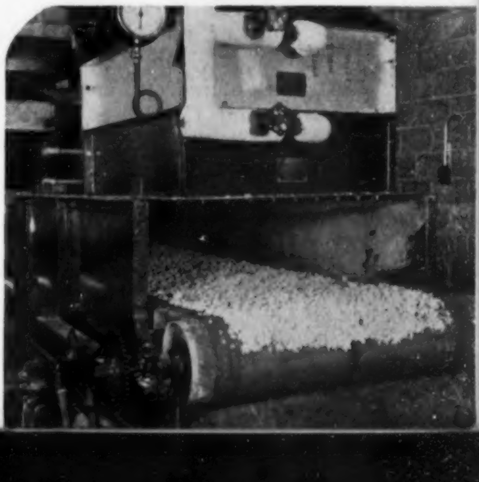


Fig. 7—On a continuous dryer belt the last traces of water are removed from the flakes and they are passed on to a hopper-feed drum loader

Are Industrial Wastes Always Liabilities?

By F. W. MOHLMAN
CHIEF CHEMIST, SANITARY DISTRICT OF CHICAGO, ILL.

Editor's Note—Dr. Mohlman, in addition to his heavy responsibilities with the Sanitary District of Chicago, is editor of *Sewage Works Journal*, in the January 1938 issue of which the following article appeared *in extenso* as a signed editorial. The author's long experience and close contact with the chemical engineering problems of waste disposal make his viewpoint most valuable.

CONSERVATION is the slogan of the day, whether it be of natural or industrial resources. Wanton waste is abhorrent to an enlightened civilization. If we have the ability to solve the intricate problems in the production and improvement of industrial products, we also have the ability to solve the problem of satisfactory disposal of wastes produced by such processes. It is frequently said by manufacturers that no methods of treatment are known for their wastes. As a matter of fact, there are probably technical means for treating all industrial wastes, and the only thing that stands in the way of the Utopia of wasteless industry is the question of cost. Every problem involves a balance of cost of disposal against the benefits obtained, and there is no sense or justice in demands for elimination of wastes from our streams and sewage treatment works, regardless of cost.

Fortunately there are a few outstanding examples of industries which have profited by the recovery of materials, once considered wastes, but which now have commercial value. These few industries should be an incentive to the others, which still discharge residues of manufactured products to the sewers, to consider carefully the possibilities of recovering more of their raw materials. This consideration should not stop with a mere perfunctory analysis of costs and values, but research programs should be outlined, consistent and continuous studies should be undertaken in properly equipped chemical laboratories, and small-scale testing stations should be operated. Only in this way can industry convince the sanitary authorities that it appreciates the seriousness of the pollution of streams and lakes by industrial wastes.

When one considers the magnitude and complexity of the industrial waste problem, the few demonstrations of profitable recoveries of waste materials do not in truth give promise of widespread or prompt alleviation of the problem. But at least they prove that a careful study of the problem, as well as the expenditure of substantial sums of money, has been well worthwhile for some plants. Three outstanding examples of successful recoveries of industrial wastes are those of the Corn Products Refining Co., located in the Sanitary District of Chicago, the Hiram Walker Distillery at Peoria, Ill., and the U. S. Industrial Alcohol Co. at Baltimore. It is significant that all three industries use similar raw materials, primarily carbohydrates such as molasses, starch, corn, rye and other cereals. Recovered products are stock feeds which always find a ready, although fluctuating, market. It seems logical to assume that in other types of industries, the solids recovered or kept out of the wastes might also be salable, even though at a reduced value.

A brief consideration of the progress in other industries indicates that recovery of more or less of the waste materials may be possible, but finally some process of treatment allied to sewage treatment, or evaporation, may be required. In the brewing industry, for example, spent grains are generally recovered by dewatering in expellers and steam drying. The expeller discharges a highly concentrated and putrescible liquor. The fermentation industry is making a commendable effort to find out how much can be recovered within its factories. Jensen, in Denmark, has developed processes for the treatment of these wastes and the Standards Brands Corporation in this country has been carrying on extensive research for several years on the treatment of yeast wastes. Commercial Solvents Corporation has also studied the problem and the Hiram Walker plant has installed and is operating equipment which is claimed to recover practically all of the organic solids. Other distilleries are making some effort toward a study of the problem.

Tanneries recover hair, but little effort has been made to recover lime, chrome salts or fertilizer. The Tanners' Council started out bravely to attack this problem years ago, but not much has been heard from them recently. Treatment of tannery wastes has been studied at length, but little effort has been made to conserve waste substances within the tannery. Paper mills have made great progress in the recovery of fiber, but the basic sulphite and sulphate processes still discharge a large proportion of the weight of wood as wastes. Phenol wastes from byproduct coke plants are probably the most widely publicized and condemned of all industrial wastes because of their effects on the taste of public water supplies. The progress that has been made in the extraction of phenols from these wastes is well known and processes are available that will remove at least 90 per cent of the phenols.

Chemical wastes are of infinite variety, but on the whole they are of less serious significance than those just discussed. Large tonnages of acids can be discharged into sewers or streams, if care be taken to balance the acidity against the available alkalinity of the sewage or water, and uniform discharge of acid be provided. Precipitation, aeration or evaporation within the plant may result in substantial reduction of wastes.

In this brief review of the status of some industrial waste problems, it is apparent that while such wastes are almost universally liabilities to the sewer authority, they may not be liabilities to the manufacturer. After entrance into the sewer, hope of profitable recovery practically vanishes. Therefore, industry should exhaust every possibility of recovery within the factory by establishment of research groups of chemists and engineers charged with the responsibility of determining what improvements of processes and recoveries of materials may be accomplished. The time is short before pressure for alleviation of pollution by industrial wastes becomes urgent. National legislation may not condone local complacence. Therefore, if industry has to spend money for waste treatment, it would be wise to start now to study how such wastes can be diminished in volume and strength.

Readers' VIEWS and COMMENTS

Charleston's Place on the Map

To the Editor of Chem. & Met.:

Sir:—In connection with the publication of an editorial supplement to your February issue entitled "Chemical Process Industries of the United States," with accompanying maps and charts, permit me to suggest that you may have unintentionally and inadvertently done an injustice to the great chemical manufacturing area of the Charleston district, recognized as one of the outstanding centers of this kind in the United States.

In this presentation, the incidence of the manufacture of chemicals and allied products is chartered for 33 so-called industrial areas of the United States as the same are defined and designated by the United States Census Bureau in its census of manufacturers for 1929. (One or more contiguous counties in which at least 40,000 were earners were reported.)

The general legend points out that approximately 63 per cent of the census classification of "Chemicals and Allied Products" are manufactured in these areas, which areas are, however, of a general manufacturing nature and not necessarily or primarily devoted to chemical manufacture.

In the 37 per cent of the industry not accounted for in your comparative charts is included Charleston. Employment in our chemical industries exceeds that of 27 of the 33 districts charted in your survey, is at least equal to that of three others, thus leaving only three metropolitan districts—New York Chicago, and Philadelphia—outranking the Charleston area. The industry here is one of almost pure chemical manufacture. If allied processes were omitted from the comparison, our ranking would doubtless be even higher with respect to the areas mentioned in your survey.

Upward of 150 chemical compounds are manufactured here, nearly all of which are products of the "strictly chemical industries." Many of them are made for and used solely in other industrial processes and do not reach the retail market as merchandise usable by the general public. The value of our products is estimated at from 50 to 75 million dollars annually. From 7,500 to 10,000 persons are normally employed. There is little or none of the allied process industry such as firearms, ammunition, yeast and other leavening compounds, blueing, candles, drugs and medicines, explosives, fireworks, glue, soap, etc.

The editorial staff of your magazine is so well aware of the outstanding importance of the Charleston chemical industry, both nationally and internationally, that no elaboration or description of it is in order here. To the casual reader and student of your survey, however, the omission of Charleston from any national survey of the industry makes the picture incomplete, to say the least.

Your use of the framework of 33 general industrial areas of the United States for comparative presentation of the industry has no doubt resulted from its availability at the only source of official figures—the United States Bureau of the Census. In some instances, however, these areas have slight relationship to the chemical industry. One of these 33 areas is located in West Virginia. It is a great industrial district. On your supplement, however, it is shown with but 215 employees in chemical and allied industry and ranks thirtieth among the 33 general industrial districts in your chart of chemical and allied industry. The Charleston area, some 35 times greater in chemical employment and probably 20 times greater in value of its chemical products, is omitted.

It is unfortunate that there has not been available to your publication a more recent census of manufacturers than that of 1929. The Charleston area could qualify under the specifications used at that time to designate the 33 industrial areas. This, however, is not a matter for which your publication is responsible or with which it is directly concerned.

CHARLES E. HODGES
Managing Director
Charleston Chamber of Commerce
Charleston, West Virginia

Chem. & Met.* sincerely regrets any injustice done to Charleston, W. Va.—so often referred to as "The Country's Chemical Capital." Data used were from 1935 rather than 1929 Census, but as Senator Hodges points out, the basis for selecting the 33 industrial areas goes back to the Government's earlier and now obsolete rating according to *general* industrial employment in 1929. Other chemical centers similarly included in the unclassified 37 per cent are Kingsport, Tenn., Richmond-Hopewell, Va., and Birmingham, Ala.—*Editor.

A SPARGER IS NO PRETZEL

To the Editor of Chem. & Met.:

Sir:—In your March issue there is pictured and described on page 155 a "sparger called a pretzel" which is said to "save steam in a beer still in the alcohol plant of a sugar refinery."

The writer first saw this use of exhaust steam in beer stills 40 years ago but it was old then and universally used. No "spargers" were installed because the steam was divided in passing through the holes in the lowest plate of the Savelle column which is the basis for this class of continuous still.

A sparger is defined in the latest (and all preceding) Websters as a revolving set of arms that sprinkle the mash to wash it in the brewery. There is no other definition of a sparger than a sprinkler, and if it does not sprinkle it is not a sparger. A pretzel is a contorted bun consumed mostly in bars in the Chemists' Club and elsewhere.

In science one should be a purist in language, that the reader may get the same idea that the writer is trying to express. This makes science exact; the lack of univocal words in discussing political economy instead of constant use of equivocal is what gives rise to the endless disputes over differences of view.

Those who use the jargon of a trade confuse those who listen to strange words to convey ideas that are old to the listeners. It is useful to those in one industry who engage in the same physical "unit operations" or chemical "unit processes" to investigate those used in older industries which have developed the best machines and technique.

Many industries have worked for years with obsolete apparatus and processes while neighboring industries had performed these same chemical opera-

tions—with far superior machinery and methods. As an example, the petroleum industry before the World War knew nothing of the Savalle or Derosne rectifying stills long used in the alcohol industry. When they discovered and adopted them they invented a new jargon which makes their old apparatus and methods seem new.

H. O. CHUTE

Chemical Engineer
New York, N. Y.

BUT PRETZELS GO WITH BEER

To the Editor of Chem. & Met.:

Sir:—Brother Chute in his search for "What's wrong with the picture" missed the important point, an error of the reporter. The sparger does not save steam. The still requires just as many B.t.u.'s as it always did, but the addition of this sparger to the old one permits the B.t.u.'s to be delivered by way of low pressure exhaust steam instead of live steam, and thus consumes the exhaust formerly lost to the atmosphere—tweedle dee and tweedle dum. All of our beer stills use the ancient spargers which were built and thus named by an internationally known builder of stills for alcohol and petroleum. I don't like the term myself but Webster does not offer a substitute.

The sparger had to be installed through a 11x15-in. manhole in four hours time. It was made by the plant maintenance man. The stem was cast by the neighborhood foundryman out of our scrap copper. I think to most engineers, the workmanship illustrated in the picture is more important than the fact that Webster's lexicographers have not provided a name for the object. A practical engineer who has accomplished things with men and tools for 40 years knows that men apply nicknames. In spite of the discomfort of working under high pressure in the steaming beer still, the men had the humor to laugh when someone observed the similarity to the pretzel and its connection with the beer still!

DAN GUTLEBEN

Plant Engineer
Pennsylvania Sugar Co.
Philadelphia, Pa.

Chem. & Met's statement that the sparger saves *live* steam is correct. Although the sparger-using still requires no fewer B.t.u.'s, it utilizes what was formerly waste exhaust steam and thus saves an extra load on the boilers of approximately 800 hp.—*Editor.*

TRANSPORTATION AND PROFITS

To the Editor of Chem. & Met.:

Sir:—I have just read with considerable attention your entire fifteenth annual review number, February, 1938. But I may add that I consider all numbers of your journal as indispensable to the traffic department.

I read with much interest the article entitled "What the Transportation Department Reports" by James G. Lyne, page 70 of the February number, and I am constrained to acknowledge openly the force of much of what he says with respect to the wise approach by traffic men to the transportation problems facing the chemical industry.

My main reason for writing you, however, was to commend you for the insertion and publication of this article in your journal. If the chemical industry is to progress on a well-rounded program it is apparent that the traffic policies must coordinate with the broad managerial policies which generally look beyond the immediate dollar to the cultivation of more profitable sales and markets of the future.

Moreover, let me add that the value of your journal to the traffic department consists very much in the statistical data peculiar to the various lines of chemical industries, and if anything I believe it would be helpful generally to your readers to have the statistical figures made more comprehensive and specific in each number, or at stated intervals either quarterly or semi-annually. Statistics are not always as dry reading as generally supposed, and in the chemical industry they are indispensable to every department. Let me say that I would not know what to do without *Chem. & Met.*

C. E. WIDELL

General Traffic Manager
Tennessee Products Corp.
Nashville, Tenn.

RECENT BOOKS AND PAMPHLETS

Finding Your Work, by J. Gustav White. Association Press, New York City. 64 pages. 35 cents. Vocational first-aid for puzzled youth and handbook for counselors. Helpful pointers on the proper use of counsel in finding a vocation or a job, whether in engineering or any other field. Tells what vocational counsel is, how it helps, how and where to get it, and pitfalls to be avoided.

British Government Publications, Consolidated List for 1937. His Majesty's Stationery Office, Kingsway, London W. C. 2. 534 pages. 35 cents net.

British Chemical Plant, 1938. Official directory of British Chemical Plant Manufacturers' Association, London W. 1. 88 pages. Issued gratis to inquirers interested in the purchase of chemical plant. A classified buyer's directory of British chemical plant equipment and services. Gives trade names, trade marks, proprietary names and manufacturer.

Recherches sur le Depoussierage Electrique, by O. Dony-Henault, Ramlot Freres et Soeurs, 25 Rue Gretry, Brussells, Belgium. 95 pages. 3 belgas.

Dechema Werkstoffblaetter, by Dr. E. Rabald. Verlag Chemie, G.m.b.H., Berlin, 1937. 104 pages. 7.50 RM. A classified index of world literature from 1934 through 1937 pertaining to materials of construction used in chemical plants.

The Manometer and Its Uses, by J. B. Meriam. The Meriam Co., Cleveland, Ohio. 50 pages. Free. Discusses principles of manometer operation and describes various types of manometers and their use for special industrial applications. Also contains conversion tables for various indicating fluids, instructions for installation, and tables for the measurement of open flows of gas wells.

Report of the Fuel Research Board (British) for the Year Ended March 31, 1937. Published by Department of Scientific and Industrial Research, Great Britain. Available from British Library of Information, 270 Madison Ave., New York City. 213 pages. Price, 3s. 6d. This annual report, which summarizes all of the research progress of the Board, makes evident again the fact that the United States has gone far ahead of Britain in many engineering phases of coal carbonization. It does, however, contain much new and useful information for American engineers connected with fuel processing—petroleum as well as coal.

Annual Reports of the Progress of Applied Chemistry, Vol. XXII, 1937. Published by the Society of Chemical Industry, Clifton House, Euston Road, London, N.W. 1. 818 pages. A well organized survey of world accomplishments in industrial chemistry during 1937. The thorough covering of the pertinent literature of that year, along with the convenient index of subjects and investigators, makes the book a valuable reference.

Copper in Cast Steel and Iron. Issued by Copper Development Assn., Thames House, Millbank, London, S.W. 1. 136 pages. Technical data dealing with the influence of copper additions on the properties of cast steel and cast iron. Of interest to foundrymen, metallurgists and engineers.

Dictionary and Manual of Fireworks. By George W. Weingart. Bruce Humphries, Inc., Boston, Mass. 172 pages. $3. A collection of recipes and methods for making all types of pyrotechnical articles for display purposes and distress signals. Written in non-technical language, describes both commercial and home methods of manufacture.

Introduction to the Use of Beilstein's "Handbuch," second edition, by Ernest H. Huntress. John Wiley & Sons, Inc., New York City. 44 pages. $1. This replaces the original pamphlet which explained the method of classification of organic compounds used in the fourth edition of Beilstein's *Handbuch der Organischen Chemie.* The new pamphlet contains additional text, particularly on the classification of heterocyclic compounds, and brings up to date the charts comprising the nucleus of the system. It is interesting to note from the pamphlet that "at least one large industrial organization engaged in the manufacture of organic chemicals has developed a chemicals filing code based entirely on the Beilstein system."

La Metallurgie Thermique du Zinc, 1931-1938, by Octave Dony-Henault and Claude Decroly. Published by Georges Thone, Liege, Belgium. 266 pages. $3. A series of six papers on the thermal metallurgy of zinc based on experimental work at the University of Brussels.

Spectroscopy in Science and Industry. John Wiley & Sons, Inc., New York City. 134 pages. $3. Proceedings of the Fifth Summer Conference on Spectroscopy and Its Applications. Contains 29 technical papers on varied aspects of this subject.

Preventive Engineering Series, Bulletin No. 2, Part I, The Determination of Benzol Vapor in the Atmosphere, Part II, The Use and Care of Respirators. Each part 8 pages. Air Hygiene Foundation of America, Inc., Pittsburgh, Pa. The first of a series of pamphlets on practical engineering measures for combating occupational disease.

Handbuch der Metallbeizerei—Nichteisenmetalle, by Otto Vogel. Verlag Chemie, G.m.b.H., Berlin W35. 262 pages. RM 16.50. The general and practical aspects of the pickling of nonferrous metals are covered in an exceptionally complete manner. The greater part of the text is devoted to industrial methods with extensive descriptions of equipment. There is also considerable material on recovery and regenerative systems for acids and solvents.

British Plastics Year Book, 1938. British Plastics, 19-23 Ludgate Hill, London, E.C. 4. 596 pages. This edition of the catalog of the British plastics industry retains its usual directories of manufacturers, equipment, products, associations and "Who's Who", the last considerably enlarged.

Chemical Engineer's BOOKSHELF

Petroleum's Prolific Progress

The Chemistry of Petroleum Derivatives, Vol. II. By *Carleton Ellis.* Published by the Reinhold Publishing Corp., New York City. 1,464 pages. Price $20.

Reviewed by *S. D. Kirkpatrick*

IN THE short period of 40-odd months since the issue by Mr. Ellis of the first volume of this title, one would scarcely believe that there have been at least 7500 significant contributions to the literature of petroleum chemistry. Yet if this reviewer did not err in his count, there are even more than that number of references to important articles and patents in the 54 chapters of this great book. Very few go back beyond 1934.

Not all of this research activity has come out of the oil industry, however, for as was true of the earlier text, this book is concerned with all chemistry and technology that relates in any way to the petroleum hydrocarbons. Organic chemistry dominates, to be sure, but the important chapters on sulphur and sulphonation, nitrogen and nitration, and the utilization of lead and other byproducts of refining suggest many inorganic aspects. And the growing importance of physical chemistry to petroleum technology is reflected in the concluding chapter on thermodynamics. Here the earlier work of Lewis and Randall in the inorganic field and the more recent work of Parks and Huffman on the free energies of organic compounds form the background from which the author has drawn a most interesting and valuable summary of contemporary trends and concepts.

In his preface, Mr. Ellis states quite frankly that the present book is essentially a continuation of the 1934 volume, made necessary by the vast amount of new information now available. It follows somewhat the same form and type of treatment although varied to recognize the timeliness of such significant developments as have occurred in the polymerization processes in this country and the hydrogenation and kogasin syntheses that are now assuming so much importance in Germany.

From this comment it is perhaps already apparent that the book deals with current industrial problems and developments rather than those of classic or historic interest. And it also accomplishes most effectively the objective that this veteran author and inventor has set for himself in all of his recent books, namely, to give us a comprehensive record of all the important work in a rapidly growing field in which information is widely scattered and never critically collated. He should be encouraged—and rewarded—even to the extent of $20 per 1500-page volume.

THEORETICAL CATALYSIS

Catalysis From the Standpoint of Kinetics. By *Georg-Maria Schwab.* Translated from the German by Hugh S. Taylor and R. Spence. Published by D. Van Nostrand Co. Inc., New York City. 357 pages. Price, $4.25.

Reviewed by *E. Emmet Reid*

IT IS INTERESTING to contrast this book with Sabatier's "Catalysis." This book is concerned with the how and the why; Sabatier's has to do only with the what. Sabatier, the great experimental pioneer, is mentioned only five times in this book and Ipatieff not at all, while such men as Bredig, Brönsted, Goldschmidt, Hinshelwood, Polanyi, Schwab and Taylor, who have developed theories of catalysis, appear many times.

After two introductory chapters the book may be divided into two parts: Chapters III to IX on homogeneous catalysis in gases and solutions, and Chapters X to XVIII on heterogeneous catalysis. Each topic is systematically and thoroughly developed with abundant literature references. In some cases alternative or even opposing theories are presented with the arguments for each. The original German edition contained 462 references. The author and the translators have added 266 to bring the translation up to date. The fact that the author and one of the translators have been among the most active in developing the theoretical side of catalysis adds much to the authority of the book. It is of great interest from the standpoint of the theories of catalysis and will be of real service to those who want to use the theories to guide them to better practical results.

APPLIED METALLURGY

Engineering Metallurgy. Third edition. By *Bradley Stoughton* and *Allison Butts.* Published by the McGraw-Hill Book Co., Inc., New York City. 525 pages. Price, $4.

Reviewed by *William P. Wood*

THE NEW edition of this widely used text reflects the constant improvement and expansion taking place in the production and application of metals and alloys. While largely designed for the non-metallurgical student, it has proved to be of value as a book for the use of students beginning the specialized study of metallurgy. At first glance it might appear that some of the material useful for this latter class of students, and which was found in the last two chapters of the previous edition, had been deleted. On further examination, however, it will be found that this material has been somewhat condensed and incorporated in the chapter on chemical metallurgy. This really makes a more logical arrangement.

One of the strong points of the book has been its treatment of the subject of the properties and applications of metals. Tables of mechanical properties and chemical analyses were a helpful part of these discussions. Such material is too frequently not included in textbooks. It is this phase of the book which has been considerably enlarged and improved in the new edition. A new chapter entirely devoted to the applications of metals in engineering service has been added. Three brief appendices dealing with the classification and heat treatment of steel are placed at the end of the book.

FACTUAL ECONOMICS

The Mechanics of Prosperity. By *Hobart C. Dickinson.* Published by The Williams & Wilkins Co., Baltimore, Md. 136 pages. Price, $2.

Reviewed by *R. S. McBride*

ENGINEERS will enjoy reading this factual scientific treatment of fundamental economics by a Bureau of

Standards physicist. It is a very satisfying interpretation of the forces which affect "money" and contribute to the economic well-being or distress of humanity. The author's statement in his preface does a better job in describing the purpose and scope of the book than could the reviewer. He says:

> The problem is treated as in the "exact" sciences, first defining assumptions which appear to be plausible, deducing conclusions to which they must lead, then checking both against facts which are known, until assumptions are found and conclusions are reached which are consistent with each other and with the facts of history. Then and only then will the student of the "exact" sciences accept conclusions as a valid guide in interpreting facts as they are.

Any technical man who is annoyed, or even more upset, by typical "reasoning" of economists, will find a real clarification for his thinking in this scientific effort. It does not solve all of the problems, nor offer a flock of remedies. Therein lies much of its merit. It sticks to sound reasoning, and then tests the result against facts. It is not easy reading, but it is well worth while for one who is confused by the hubbub of current economic argument.

LITERATURE OF LATEX

LATEX AND RUBBER DERIVATIVES AND THEIR INDUSTRIAL APPLICATIONS VOL. II AND III. By *Frederick Marchionna*. Published by Rubber Age, New York City. 1,670 pages combined. Price, $20 (not sold separately).

Reviewed by *A. R. Kemp*

THE RAPIDITY with which developments in the field of latex chemistry have taken place during the past few years is evidenced by these two large volumes in which the author has abstracted the patent and scientific literature on the subject between the years 1933 and 1937. This supplements his corresponding earlier work in which the literature is covered up through 1933.

Vol. II includes thirteen chapters on uses of latex in industry, while Vol. III contains nine chapters which deal with different rubber derivatives of commercial value. The following well known rubber technologists have contributed introductory articles to certain chapters: John McGavack, D. F. Twiss, A. Szegvari, C. L. Beal, P. Schidrowitz, G. A. Richter, Milton O. Schur, L. B. Sebrell, E. H. Morris, Harry L. Fisher. The index arrangement of authors, patentees, patents, and literature abstracts affords easy reference to these items. The patent abstracts cover novelty of disclosure in addition to advances made in the particular field.

The three volumes of Marchionna's work, which contain nearly 7,000 abstract items, fill a definite need for a ready reference in the fields covered. Although some errors might be found on close scrutiny, they are insignificant in the mass of reliable information contained in these volumes. The importance of the subject is indicated by the fact that practically all large rubber companies in this country have organized latex divisions in their manufacturing plants during the past few years.

FUEL SAFETY

NATIONAL FIRE CODES FOR FLAMMABLE LIQUIDS AND GASES. Published by National Fire Protection Association, 60 Batterymarch St., Boston, Mass. 360 pages. Price, $1.50.

Reviewed by *R. S. McBride*

FUNDAMENTAL PRECAUTIONS for safety to life and property are splendidly formulated in the codes and recommended regulations which have been drafted under the auspices of N.F.P.A. This organization has been served by committees made up of the ablest men available in the country who have worked seriously for the cause of protection against fire and personnel hazard. Fortunately these committees have been made up of practical men—engineers and insurance workers who know that the unworkable regulation is not a benefit to anyone. Rarely, therefore, does one find any real hardship in the rigid application of the rules, ordinances, or regulations suggested by N.F.P.A.

This present volume serves a very useful purpose in bringing together in one convenient book a wide variety of findings of N.F.P.A. which have hitherto been available in oddly sized and irregularly prepared pamphlets. Every chemical engineering enterprise will need to get and use the document. Among the technical subjects to which it relates are most importantly, but not exclusively, the following: flammable liquids, fuel oil tanks, freeing tanks of flammable vapors, liquefied petroleum gas, compressed gas systems, acetylene, dip tanks, paint spraying, city gas, odorization of gas, gas shut-off valves, gas producers, and gas systems for welding and cutting.

SPOT ANALYSIS

QUALITATIVE ANALYSIS BY SPOT TESTS —INORGANIC AND ORGANIC APPLICATIONS. By *Fritz Feigl*. Published by Nordemann Publishing Co., New York City. 379 pages. Price, $7.

Reviewed by *W. L. Abramowitz*

ANALYSIS by spot tests represents an ultimate goal in analytical chemistry. The concept of identifying substances by mixing a drop or so of unknown with a drop of reagent has long been the dream of chemists—particularly of students. Unfortunately, in spite of the excellence of Feigl's book, the methods of spot analysis for the most part still require special micro apparatus, careful manipulation, and comprehensive understanding of the principals involved.

During the eight years since the first edition of the book, the applications of spot analysis have multiplied tremendously. Many of the better universities and colleges have already accepted the methods as a required study in their chemical curriculum.

The subject matter of the book is roughly divided into four parts; general theory and apparatus, inorganic analysis, organic analysis, and industrial applications. Some of the more important of the latter include detection of small amounts of metals in alloys, minerals, pharmaceutical and cosmetic products, and in foodstuffs, analysis of water, differentiation of fibers and hairs, detection of impurities in industrial chemicals, and tests for definite groups of dyes. Charts and summaries of tests scattered generously through the book greatly add to its usefulness.

The general simplicity of the analytical procedures give great promise for future development. It would well be worth the labor for industrial analytical laboratories to investigate this important art so clearly set forth by Professor Feigl.

PATENT LAW FOR CHEMICAL ENGINEERS

THE LAW OF CHEMICAL PATENTS. Second edition. By *Edward Thomas*. Published by D. Van Nostrand Co., Inc., New York City. 570 pages. Price, $9.

Reviewed by *Robert E. Sadtler*

THIS second edition of Thomas' book is an enlarged and improved form of the original which was published eleven years ago. The author develops his subject in logical order from fundamental precepts and general rules, concisely stated and followed by pertinent excerpts from the decisions of the Patent Office and the Federal Courts. These excerpts substantiate the precept and give specific applications as well as exceptions. The treatise can, therefore, be considered as both a textbook and a legal digest.

The book consists of 21 chapters which cover the following main subjects: nature of patents and patentable processes; anticipations by prior uses and prior publications; nature of a valid claim; types of infringements; permissible amendments; double patenting and the joinder of inventions; assignments, licenses and royalities peculiar to chemical patents; contests between rival claimants; patent suits and patent evidence.

The author has apparently made a faithful effort to accurately and fully enunciate the existing law on the subjects covered, but it is felt that where

conflicting decisions are cited it would have been helpful to indicate what point of view represents the weight of authority. Also, in the excerpts of decisions in which the courts made erroneous scientific statements, no attempt has been made by the author to indicate such statements by means of appropriate notes. As a whole, however, the book should be of value to the engineer and chemist who may be confronted with chemical patent problems.

FERTILIZER PRACTICE

THEORY AND PRACTICE IN THE USE OF FERTILIZERS, Second Edition. By *Firman E. Bear*. Published by John Wiley & Sons, Inc., New York City. 360 pages. Price $4.

Reviewed by *H. R. Smalley*

THE FIRST EDITION of this book (1929) was written while the author was professor of soils at Ohio State University. Thereafter he was director of agricultural research for the American Cyanamid Co. for eight years, and is now science editor of *Country Home*.

The book is considered one of the best of the standard texts on fertilizers. In it the author has brought together the various points of view concerning fertilizer practice that have been developed by many workers during the past 100 years.

Much progress in the manufacture and use of fertilizers has been made during the nine years that have elapsed since the first edition was published, and the author has, therefore, made a number of changes throughout the text, has rewritten several chapters and has added a chapter dealing with the minor elements. Some of the new subjects that have received special attention in the second edition are: the acidity and basicity of fertilizer and of fertilizer materials, the use of synthetic nitrogen materials, the ammoniation of superphosphate, the development of granular fertilizers, methods of applying fertilizers, and soil testing.

The book should appeal especially to those who, although not technically trained as agronomists, desire a general knowledge of the use of fertilizers.

KORROSIONSTABELLEN METALLISCHER WERKSTOFFE. By *Franz Ritter*. Published by Verlag von Julius Springer, Berlin, Germany. 192 pages. Price, RM 19.80.

SEVERAL HUNDRED corrosive materials are listed in convenient table form, showing extent of corrosive attack in grams per square meter per day for a number of recommended resistant alloys. The work is a valuable and essentially complete handbook of metallic corrosion data. The original sources of much of the material are given, so that the volume is of bibliographic value as well.

PROCEDURE HANDBOOK OF ARC WELDING DESIGN AND PRACTICE. Fifth Edition. Published by the Lincoln Electric Co., Cleveland, Ohio. 1,012 pages. Price, $1.50 in the United States, $2 foreign.

DESIGNERS and welders familiar with previous editions of this handbook will find that it now covers even more completely the broad field of welding technique and the design of arc-welded steel structures and machinery. Outstanding among the new material are the additional studies on machine parts made from standard rolled steel shapes, the new structural calculations based on up-to-date sizes of mill shapes, some additional data on the welding of thin plates and thick plates, and the six new studies on the design of trusses.

QUALITATIVE ANALYSIS. Second Revised Edition. By *H. V. Anderson* and *T. H. Hazlehurst*. Published by Prentice-Hall, Inc., New York City. 280 pages. Price, $2.25.

Reviewed by *M. E. Clark*

IN VIEW of the much publicized fact that scientists have difficulty in expressing themselves in writing, these authors have done a remarkable job. Beginning with the fundamental theory of atoms and valence, they have unfolded in 108 short pages a most interesting account of qualitative analysis. The book is exceptionally readable—largely because of the authors' very logical development of their subject from the atomic theory of matter through solutions, Le Chatelier's principle, and the theory of precipitation to reactions of acids and bases and oxidation and reduction.

Following the theory are 143 pages on procedure for analysis of cations and anions complete with outline, flowsheet and detailed explanation for each group. Frequent reference to the theory and some additional theory are emphasized, and the student is urged to figure out many reactions for himself as well as to draw up one of the outlines himself. In addition there are 10 pages of valuable tabular material in the appendix and numerous practice problems, but nowhere is there a reference to any other work on the subject.

LABORATORY TECHNIQUE IN ORGANIC CHEMISTRY. By *Avery A. Morton*. Published by McGraw-Hill Book Co. New York City. 261 pages. Price, $2.50.

THIS new volume of the International Chemical Series by Professor Morton of M. I. T. fills a need long felt in experimental organic chemistry—the only other book of its kind being in German, and already somewhat out of date. The material is essentially an extension of a laboratory course in technique and presents the fundamentals governing various physical manipulations and equipment. It constitutes an extremely useful hand and reference text for the industrial chemist, covering among other operations, drying, fractional, vacuum, and steam distillation, crystallization, filtration, adsorption, and extraction. Enough theory is included for intelligent utilization of the methods.

SEGMENTAL FUNCTIONS, TEXT AND TABLES. By *C. K. Smoley*. Published by C. K. Smoley & Sons, Scranton, Pa. 482 pages. Price, $5.

THIS BOOK offers for the first time a complete tabulated method for the solution of problems involving the functions of circular segments. The application of trigonometric functions to the solution of the triangle is, of course, well known. By an analogous method, similar treatment can now be accorded to segments of circles. Whereas the triangle has six parts: three sides and three angles, the segment has five principal parts: the arc, the chord, the radius, the central angle and the height between chord and arc. In the triangle, if three parts (including at least one side) are known, the remaining three parts can be determined. In the segment, knowledge of two parts permits calculation of the other three, as well as the area.

Functions are presented largely in the form of their logarithms, except in certain tables where natural values are also given. In adition, the book includes a second section in which are reprinted certain tables from the author's earlier handbooks.

DIRECTORY OF THE ASSOCIATION OF CONSULTING CHEMISTS AND CHEMICAL ENGINEERS, INC., 1938. Published by the Association, 50 East 41st St., New York City. 60 pages. Free upon request to the Association.

THE DIRECTORY is brought up to date with this edition, which gives in its usual convenient and detailed form the personnel, facilities, scope and activity of the 41 chemical and chemical engineering consulting firms which comprise the membership of the Association.

COLLATERAL READINGS IN INORGANIC CHEMISTRY. Edited by *L. A. Goldblatt*. Published by D. Appleton-Century Co., New York City. 225 pages. Price, $1.35.

DESIGNED especially for students of general chemistry, this book presents a collection of 31 selected articles which appeared in American technical journals between 1912 and 1937. The selection has been carefully made to include a number of significant industrial inorganic processes as well as some interesting biographical and historical material. Appropriate notes and discussion accompany each article. A

photostatic process has been used to reproduce the articles themselves from the originals so that no details, charts or illustrations are missing. The chemical engineer interested in a general and not too technical review of applied inorganic chemistry will find the book readable and informative.

THE MELLIAND. Edited and published quarterly by Marcel Melliand, Heidelberg, Germany. Price, $2 per copy, $8 per year.

TO PROVIDE a world clearing house for technical and industrial information on textile chemistry and coloring is the aim of this new German quarterly printed in English. The sample copy submitted for review has a sturdy board binding and contains 152 pages of text, 100 consisting of contributed articles arranged under the four general headings of raw materials, washing, dyeing, printing, and finishing, and 45 containing abstracts of current textile literature from all parts of the world. The editorial advisory committee of the publication consists of representatives from twelve different textile producing countries. Dr. J. Saxl of Providence, R. I. is the American member.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Industrial Fumigation Against Insects, by E. A. Back and R. T. Cotton. Department of Agriculture Circular 369,. Revised December, 1937; 10 cents.

Composition and Fractionation of American Steam-Distilled Wood Turpentine, by S. Palkin and others. Department of Agriculture, Technical Bulletin 596; 5 cents.

The World Sugar Situation, 1937. Bureau of Agricultural Economics, unnumbered document; mimeographed.

Development of Standard Grades for Cottonseed, by G. S. Meloy. Bureau of Agricultural Economics, unnumbered document; mimeographed.

Chemical Seasoning of Douglas Fir, by W. Karl Loughborough. Forest Products Laboratory, Madison, Wis., unnumbered document; mimeographed.

Fishery Industries of the United States, 1936, by R. H. Fiedler. Bureau of Fisheries, Administrative Report No. 27; 25 cents.

Information on Ultraviolet Transparency of Window Materials and Fabrics. Bureau of Standards, Letter Circular 511; mimeographed.

Willing to Certify Sources of Supply of Commodities Covered by Commercial Standards. Bureau of Standards, Letter Circular 277a, revised to Sept. 1, 1937; mimeographed.

Trends in the International Leather Trade, 1926–1936, by J. G. Schnitzer. Bureau of Foreign and Domestic Commerce, Leather and Rubber Division, Special Circular No. 1245; mimeographed.

Foreign Commerce and Navigation of the United States, Calendar Year 1936—Vol. 1, Imports. Bureau of Foreign and Domestic Commerce; $1.50 (buckram), 441 pages.

Trade of the United States With Canada. Bureau of Foreign and Domestic Commerce, Division of Foreign Trade Statistics, Release of March 10, 1938; mimeographed.

Wood Pulp and Pulpwood. Tariff Commission Report No. 126, Second Series; 30 cents.

Dyes and Other Synthetic Organic Chemicals in the United States, 1936. Tariff Commission, Report No. 125, Second Series; 15 cents.

Labor Requirements in the Production of Clay Products, by Bernard H. Topkis. Bureau of Labor Statistics, Serial No. R. 646.

What To Do in Case of Accident. Public Health Service, Miscellaneous Publication 21; 10 cents.

Trade Agreement Between the United States and Czechoslovakia—State Department mimeographed releases giving: Analysis of the General Provisions and Reciprocal Tariff Benefits, Release No. 111, March 7, 1938; Text of General Provisions, Schedules, Protocol and Notes, Release No. 121, March 15, 1938; Proclamation of the Trade Agreement, Release No. 120, March 15, 1938.

Methods for Determination of Quartz in Industrial Dusts, by F. H. Goldman. Public Health Service, Reprint No. 1882; 5 cents.

Further Field Studies on the Selenium Problem in Relation to Public Health, by M. I. Smith and B. B. Westfall. Public Health Service, Reprint No. 1864; 5 cents.

Interrelation of Exhaust-Gas Constituents, by Harold C. Gerrish and Fred Voss. National Advisory Committee for Aeronautics, Report No. 616; 10 cents.

Stress Analysis of Beams With Shear Deformation of the Flanges, by Paul Kuhn. National Advisory Committee for Aeronautics, Report No. 608; 10 cents.

Preliminary Fatigue Studies on Aluminum Alloy Aircraft Girders, by Goodyear-Zeppelin Corp. National Advisory Committee for Aeronautics, Technical Note 637; mimeographed.

Annual Report of the National Advisory Committee for Aeronautics, 1937; 15 cents. Contains technical abstracts.

Rum—Trade, Production, and Manufacturing Methods of Principal Producing Countries, by Marion A. Leonard. Foodstuffs Division, Bureau of Foreign and Domestic Commerce; mimeographed.

Annual Report of the Commissioner of Internal Revenue, Fiscal Year ended June 30, 1937; 20 cents. Includes data on alcohol and other goods taxed by U. S.

Statistics of Capital Movements between the United States and Foreign Countries and of Purchases and Sales of Foreign Exchange in the United States, Second Quarter, 1937. Treasury Department, Division of Research and Statistics, Report No. 4; 15 cents.

Analysis of State Unemployment Compensation Laws. Social Security Board Publication No. 13, December 1, 1937; 15 cents.

Burning of Various Coals Continuously and Intermittently on a Domestic Overfeed Stoker, by H. F. Yancey and others. Bureau of Mines, Report of Investigations 3379; mimeographed.

Coal Mine Explosions and Coal and Metal Mine Fires in the United States During the Fiscal Year Ended June 30, 1937, by D. Harrington and W. J. Fene. Bureau of Mines, Information Circular 6986; mimeographed.

Some Pertinent Information About Mine Gases. Bureau of Mines, Information Circular 6983; mimeographed.

Some of the Results of Recent Research on the Control or Prevention of Silicosis, by D. Harrington. Bureau of Mines, Information Circular 6994; mimeographed.

Methods for Protection Against Silicosis and When They are Justified, by D. Harrington. Bureau of Mines, Information Circular 6989; mimeographed.

Technique for Routine Use of the Konimeter, by J. B. Littlefield and others. Bureau of Mines, Information Circular 6993; mimeographed.

Concentration of Southern Barite Ores, by G. O'Meara and G. D. Coe. Bureau of Mines, Report of Investigations, 3376; mimeographed.

Compression Tests of Roof-Salt Slabs Supported by Potash Salt Pillars, by H. P. Greenwald and H. C. Howarth. Bureau of Mines, Report of Investigations 3386; mimeographed.

Primary Crushing, by Mark Sheppard and C. N. Witherow. Bureau of Mines, Progress Report No. 1, R. I. 3377, Progress Report No. 2, R. I. 3380; mimeographed.

Survey of Fuel Consumption at Refineries in 1936, by G. R. Hopkins. Bureau of Mines. Report of Investigations 3367; mimeographed.

Annual Report of the Explosives Division, Fiscal Year 1937, by Wilbert J. Huff. Bureau of Mines, Report of Investigations 3383; mimeographed.

Ore-Testing Studies, 1936–37. Bureau of Mines Report of Investigations 3370 mimeographed. Contains sections on: Laboratory testing for cyanidation; spectroscopic analysis; analysis of molybdenum; the determination of chromite ores and concentration products; quantitative electrodeposition of cobalt; a staining method for the differentiation between feldspar and quartz; construction and operation of an Hc-Type A.C. Laboratory magnetic separator; establishment of ore-testing procedures, reports of tests.

Grindability of Alabama Coals, by Ellis H. Hertzog and James R. Cudworth. Bureau of Mines, Report of Investigations 3382; mimeographed.

Composition and Inflammability of Gaseous Distillation Products from Heated Anthracite, by G. S. Scott and G. W. Jones. Bureau of Mines, Report of Investigations 3378; mimeographed.

Bureau of Mines Analyzes Ramsey Pool, Payne County, Oklahoma, Crude Oil. Bureau of Mines Release March 19, 1938; mimeographed.

Ground-Water Resources of South-Central Pennsylvania Cooperative Report of the State and Federal Geological Surveys, by Stanley W. Lohman. Department of the Interior, Release of March 14, 1938; mimeographed.

Metal Mine Accidents in the United States, 1935, by W. W. Adams and M. E. Kolhos. Bureau of Mines, Bulletin 410; 10 cents.

Solder, Silver. Federal Specification QQ-S-56 lb; 5 cents.

Effect of Acid Lead Arsenate on Different Plants When Applied to Soil About Their Roots for Destruction of Larvae of the Japanese Beetle, by Walter E. Fleming. Bureau of Entomology and Plant Quarantine, E-418; mimeographed.

Labeling of Derris and Cube Powders and Other Rotenone-Bearing Insecticides. Food and Drug Administration, Release of February 8, 1938; mimeographed.

Efficient Method for Mixing Large or Small Quantities of Insecticidal Dusts Containing Conditioner, by T. E. Bronson. Bureau of Entomology ET-115; mimeographed.

Contents and Index of Entomological Technic (ET), Circulars Nos. 51 to 100. Bureau of Entomology and Plant Quarantine; mimeographed, December, 1937.

List of Publications of the Division of Insecticide Investigations, Bureau of Entomology and Plant Quarantine, Washington, D. C., for the Six-Month Period Ending December 31, 1937; mimeographed.

Sugar Consumption Requirements and Quotas for Calendar Year 1938. Agricultural Adjustment Administration, General Sugar Quota Regulations, Series 5, No. 1.

Determination of Farming Practices to be Carried out in Connection with Production of Sugar Beets and Sugar Cane During Crop Year 1937, pursuant to subsection (e) of Section 301 of Sugar Act of 1937. Agricultural Adjustment Administration, S. D. No. 14.

Yield and Quality of Sugar Beets From Various Rotations at the Scotts Bluff (Nebr.) Field Station, 1930–35, by S. B. Nuckols. Department of Agriculture, Circular No. 444; 5 cents.

Two New Varieties of Sugar Cane for Sirup Production, by B. A. Belcher. Department of Agriculture, Circular No. 461; 5 cents.

Effect of Fertilizers on Composition of Soybean Hay and Seed and of Crop Management on Carbon, Nitrogen, and Reaction of Norfolk Sand, by J. E. Adams and others. Department of Agriculture, Technical Bulletin No. 586; 10 cents.

Sulphuric Acid Treatment to Increase Germination of Black Locust Seed, by H. G. Meginnis. Department of Agriculture, Circular No. 453; 10 cents.

Toxicity of Arrowgrass for Sheep and Remedial Treatment, by A. B. Clawson and E. A. Moran. Department of Agriculture, Technical Bulletin No. 580; 5 cents.

Statistics of Income for 1934—Part 2, compiled from Corporation Income and Excess-Profits Tax Returns and Personal Holding Company Returns. Bureau of Internal Revenue; 25 cents.

Process Equipment NEWS

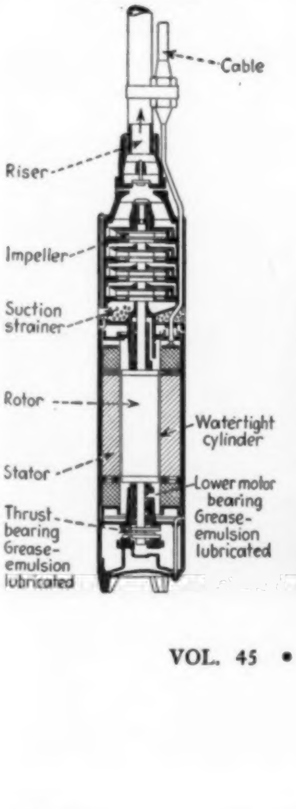
Machinery, Materials and Products

Deep Well Pump

A TYPE OF deep well pump said to be new to the United States has recently been put on the market by the American-Marsh Pumps, Inc., Battle Creek, Mich. The principle, which has been thoroughly tested for a number of years in Europe, employs a submersible motor directly connected with the pump and placed below it. This compact assembly of pump and motor is suspended from the riser pipe and operates below water in the well. A waterproof cable conducts current to the submersed motor. The new construction eliminates need for a pump house and makes for easy installation as no lining up of bearings is necessary.

This pump, designated as UTA, is of the centrifugal type with diffusion vanes, built in any required number of stages, employing phosphor bronze impellers. Pump bearings are water lubricated and are stated never to require attention. The motor uses a rotor operating in the water, but the stator is sealed within a stainless steel cylinder. Regreasing of the motor bearings is required only after 2-10 years of operation. There is said to be no possibility of contaminating the water with grease.

Cross section of new deep well pump



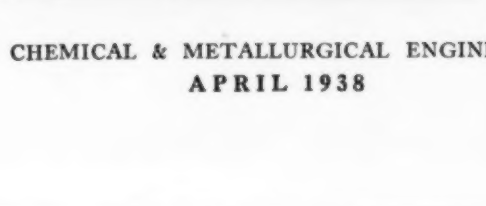
Safety Siphon

DEVELOPED by a well-known chemical plant executive, the T.P.C. safety siphon is being manufactured and distributed by Hygienic Products Corp., Portland, Me. It is intended for the emptying of carboys and has been tested and approved as a non-pressure device by the Carboy Committee of the M.C.A. The siphon consists of a tube, a rubber carboy cap, and a priming chamber operated by a hand bulb. A readily adjusted outlet valve permits delivery of acid at any rate from a trickle to 2 gal. per min. Once the siphon is primed, no further pumping is necessary.

Variable Speed Transmission

TO SUPPLY the need for a compact, flexible, variable-speed transmission unit, the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has developed and announced the Vari-Pitch speed changer, an inclosed unit employing Vari-Pitch sheaves and V-belts. Both input and output shafts are equipped with variable-pitch sheaves adjusted through a worm and worm wheel, operated either manually or electrically. The sheaves, which have previously been described, permit the Texrope V-belt to rise higher or lower in the groove, thus producing a larger or smaller sheave diameter and resulting in a change of speed. At present seven sizes are available, covering a range from 1 to 33 hp. with a speed range of 3.75 to 1 and maximum speed as high as about 3,600 r.p.m. on the output shaft. Anti-friction ball bearings are employed throughout and provision has been made for ready replacement of the belts when this is necessary.

Vari-Pitch transmission installation



This company has also announced a new series of two-groove adjustable pitch sheaves for providing speed variation up to 33 per cent on ordinary V-belt drives. The sheaves are built for loads up to 3 hp. Adjustment is made readily by stopping the motor and moving an adjustable plate.

Equipment Briefs

CLOSE ELECTRICAL CONTROL, free from chattering at the contact points, is a feature of the new electrical Pyromaster pyrometer controller recently announced by the Bristol Co., Waterbury, Conn. This member of the Pyromaster line is equipped with special relays which require the making and breaking of only one contact to effect control. The instrument is without continuously moving parts and is said to provide exceptional response to changes in the controlled temperature. Another new Pyromaster is a portable, round-chart recording pyrometer which is said to be unusually rugged in construction and not affected by vibration. No careful leveling is required prior to use. These instruments are available in temperature ranges from 0-500 to 0-3,000 deg. F. For lower temperature ranges, resistance thermometers rather than thermocouples are available.

TWO NEW ELECTRODES for manual arc welding have been announced by Metal & Thermit Corp., 120 Broadway, New York City, sales agents for American Murex Corp. One electrode is used with reversed polarity for welding mild steel in flat, vertical and overhead positions. The other is a straight polarity electrode for general purpose work, capable of bridging gaps between poorly fitted plates.

AIR REDUCTION SALES CO., 60 East 42d St., New York City, has announced the development of two new stationary acetylene generators available in capacities of 300 and 500 lb. of carbide, having rated delivery capacities of 600 and 1,000

cu.ft. of acetylene per hour. By means of interconnected controls and other safety features, the generators are said to be fully protected from line flashbacks and excessive overloads, as well as incorrect operating procedure. These devices are designated as Airco-DB double-rated generators.

OPERATING on an entirely different principle from equipment formerly produced by this company, the new Type QS magnetic separator recently announced by the Stearns Magnetic Mfg. Co., Milwaukee, Wis., is said to have twice the collecting area of its predecessors. The new equipment is intended for removing magnetic contamination from frits and slurries and instead of the usual magnet and screen cartridge, has a series of highly magnetized screens through which the liquid is filtered, the screens presenting more than 21,000 lineal ft. of active collecting edge. For use in the enameling industry, this equipment is handled by the Ferro Enamel Corp., Cleveland, Ohio.

DEVELOPMENT of an improved line of mercury-actuated thermostats, to which has been given the name Red Top Thermo-Regulators, has been announced by the H-B Instrument Co., 2815 North Broad St., Philadelphia, Pa. These instruments are designed to control temperatures with an accuracy of 0.1 deg. F. Their range of adjustment is from —30 to +500 deg. F. and the setting may be changed to hold any temperature within this range as frequently as may be desired. Setting is accomplished by tipping the instrument and transferring the mercury from the bulb to a reservoir or vice versa, as may be desired. Instruments without the adjustable feature are also available, together with a complete line of sensitive relays for current loads up to 30 amp. One type of Thermo-Regulator is made with multiple contact points, any one of which may be selected by the operator. These multi-contact instruments are provided with from 3 to 15 contacts, placed as close together as 0.4 deg. F., or as far apart as necessary.

MODEL C is the designation of a new and larger member of the Type 1 line of motor valve mechanisms produced by the Automatic Temperature Control Co., 34 East Logan St., Philadelphia, Pa. The mechanism is designed to operate slip-stem valves for heavier pressures and in the larger sizes. It is, for example, employed with the Saunders type of diaphragm valve. The operating mechanism is capable of exerting an opening and closing force of 2,000 lb. or more; and of movement at the rate of from 3 to 10 in. per min. Strokes up to 10 in. are available.

FOR DETERMINING the pressure in pipelines carrying fibrous materials such as paper stock, which would quickly plug the opening of a pressure gage, Goulds Pumps, Inc., Seneca Falls, N. Y., has developed a new "stockline" diaphragm gage connection consisting of two recessed circular flanges with a thin flexible diaphragm between them. One flange is tapped for connection to the pipeline while the other, a solid flange, provides a space which is filled with water to communicate with the gage. Pressure exerted on the stock side of the diaphragm is transmitted exactly, according to the manufacturer, through the diaphragm and to the gage.

A NEW VALVE, intended primarily for boiler blow-off, has recently been announced by the Hancock Valve Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn. A feature of the valve is a protecting lip on the plug which is said to deflect the blow-off so as to provide protection for seat and disk and make the valves almost indestructible. The stainless steel disk is hardened to 500 Brinell, while the renewable seat ring is heavily Stellited.

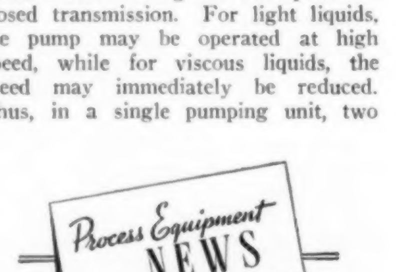
Viscous Liquid Pumps

A COMPLETE line of specially designed rotary pumps for the handling of viscous chemicals has recently been announced by the Worthington Pump & Machinery Corp., Harrison, N. J. Built in a variety of metals to suit the required service, the pumps are available in capacities to 700 g.p.m. with pressures up to 150 lb. per sq.in. and viscosities up to 110,000 centipoises.

Another new pump developed by Worthington is of the herringbone-gear-impeller type, driven by a constant speed motor through a two-speed inclosed transmission. For light liquids, the pump may be operated at high speed, while for viscous liquids, the speed may immediately be reduced. Thus, in a single pumping unit, two liquids of widely varying characteristics can be handled consecutively, and since the pump need not be over-powered, it is said to afford maximum efficiency because of the relatively small motor employed.

Process Equipment NEWS

Rotary pump for viscous chemicals



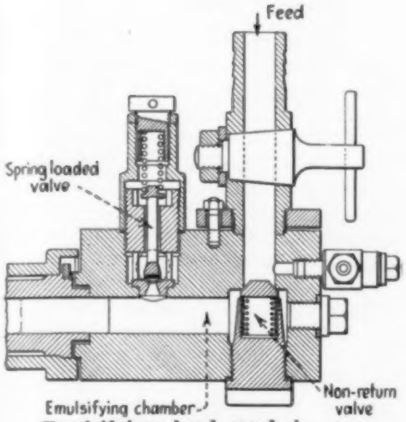
Automatic Molding Press

LAKE ERIE ENGINEERING CORP., Kenmore Station, Buffalo, N. Y., has recently developed a new automatic hydraulic molding press for quantity production of molded plastic and rubber parts. This is a fast-production, tilting-head press with automatic multiple ejection of the molded parts. Such presses are built both with self-contained pumps and for accumulator operation. Rated capacity is 1,000 tons for molds measuring 38x38 in. Automatic operation is said to make it possible for one man to run four presses.

Paper Stock Valves

ESPECIALLY DESIGNED for controlling the flow of pulp stock in pulp and paper mills, but also applicable for other purposes where fibrous solids suspended in liquids are handled, is a new line of cast iron valves recently announced by the Crane Co., 836 South Michigan Ave., Chicago, Ill. For this special type of service, the valves are designed for 60 lb. pressure, employing a rectangular flat metal sheet as a disk, having a cutting edge at the bottom which seats against a lead filler in the bottom of the body. The port on the outlet side has notches around the bottom which tend to trap the pulp stock and prevent it from accumulating at the center of the valve. As the cutting edge of the disk passes these notches, it shears off the stock. Water connec-

Multiple ejection molding press



Emulsifying head used in new homogenizer

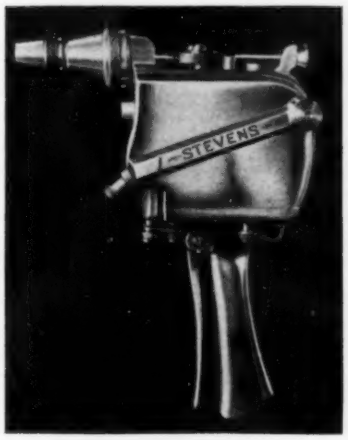

Beckman industrial pH meter

tions to the body are also provided for flushing the inside of the valve and pipe line. Sizes range from 4 to 16 in.

This company has also announced a new line of brass globe and angle valves with plug disks for severe service in small lines carrying steam, hot water, oil and similar fluids. Nickel alloy disks and special heat-treated chromium iron seats are employed. A variation of this valve employs an iron, rather than a brass, body.

Pulsating Homogenizer

One of the new devices shown at the Chemical Exposition and briefly mentioned in our Exposition report was the Impulsor emulsifier recently introduced in the United States from England by the Abbe Engineering Co., 50 Church St., New York, N. Y. This homogenizer is of the pump and valve type, but differs from earlier equipment in the employment of violent oscillations of pressure in the liquids under treatment. For example, the pressure may vary momentarily from 0 to as much as 3,500 lb. per sq. in. before the product is ejected at high velocity through a narrow orifice. This treatment is said to produce an intimate intermingling and homogenization of the two phases of the emulsion, resulting in uniform and stable products. In many cases, it is said to be possible to feed the two separate phases to the machine without pre-mixing.



New metal spray gun

The Impulsor consists essentially of a single cylinder pump to which is bolted the emulsifying head illustrated in the drawing. The liquids are introduced on the suction stroke directly into the emulsifying chamber which communicates with the pump cylinder. On the compression stroke the pressure rises to a value determined by the spring loaded valve which allows a portion of the liquid to escape at high velocity between the valve and seat.

Industrial pH Meter

Simplicity and ruggedness for industrial use, combined with laboratory accuracy, are claimed for the new industrial model of Beckman pH meter recently developed by the National Technical Laboratories, Pasadena, Calif. This instrument employs the glass electrode system, the potential of which is amplified by a special electronic amplifier to operate a calibrated meter at the pressure of a button. The electrode system and lead wire are completely shielded and it is claimed that the electrode may be used in a vat, tank, or other location at a remote distance from the meter without danger of picking up electrostatic interferences. When desired, the instrument can be used for continuous indication with the electrode placed in a flowing solution. In order to provide maximum separation between scale points, a dual scale meter is used, with a switch to change scale. The first scale covers the acid range and the second the alkaline range. The entire instrument is housed in a compact hardwood case.

Metal Spray Gun

Four new features are claimed for the new Model OZ-3 metal spray gun recently announced by Stevens Metal Spraying, Inc., 83 Shipley St., San Francisco, Calif. The unit is equipped with a gear shift as an integral part of the assembly, providing high speed for spraying lower melting metals and a low speed, half the high speed, for higher melting metals. The wire tension device is automatically controlled by movement of the gas control lever. The mechanical assembly is readily removable from the gun body and completely available for inspection. A high-capacity-type nozzle of two-piece construction is used. Tempered tool steel is used for the wire guide section. Self-lubricated ball bearing shafts are employed.

Equipment Briefs

A new member of the line of inverted bucket traps manufactured by the Sarco Co., 183 Madison Ave., New York City, is the Type BM-O which features straight-through connections. This trap is made in one size with $\frac{3}{8}$ or $\frac{1}{2}$ in. inlet and outlet connections, arranged on opposite sides of the body on the same centerline. The arrangement is said to simplify pipe connections in many installations.

Benjamin Electric Mfg. Co., Des Plaines, Ill., has developed a new 400-watt mercury lamp unit which utilizes three 150-200 watt incandescent lamps arranged around the central mercury lamp to produce a light which is said to be comfortable visually, and to blend well with daylight. A fair degree of color discrimination is said to be possible with this unit.

Dustoscope is the name of a new and simple instrument for the estimation of dust in air, developed by the Chemical Engineering Laboratories of the Travelers Insurance Co., and recently put on the market by "Service to Industry," Box 133, West Hartford, Conn. The device permits direct examination of a continuous sample of air, making particles as small as 0.5 micron easily visible. Neither microscope nor laboratory apparatus is necessary. Examination may be continued for as long a period as is required.

Tensile strength from 75,000 to 85,000 lb. per sq.in., a yield point of 60,000 to 68,000 lb. and a ductility of 20 to 30 per cent elongation in 2 in., are properties claimed for the weld metal produced from a new line of mild steel arc welding electrodes designed particularly for use on small alternating current transformer type arc welders and recently introduced by the Lincoln Electric Co., Cleveland, Ohio. The new electrodes, designated as Transweld, have a heavy extruded coating and are said to produce an exceptionally stable arc.

In cooperation with the Corning Glass Works, manufacturers of the material, the American District Steam Co., North Tonawanda, N. Y., is now supplying a new fibrous glass insulation

of the filler type for use in insulating underground steam lines. High thermal insulation efficiency and exceptionally light weight are advantages claimed for this material, together with resistance to heat, water, acids or fumes. Such insulation is stated to fluff rather than pack under vibration.

FOR AIR-CONDITIONED spaces provided with ducts, where heat requirements cannot be met with present equipment, the Bryant Heater Co., Cleveland, Ohio, has developed a new duct heater to serve as an auxiliary heat supply. The unit is designed to fit a standard 17¾-in. square duct, providing a heat input of 85,000 B.t.u. per hour. The unit is gas-fired and provided with a chromium steel alloy streamlined heat exchanger and cast iron combustion chamber and flue collector.

FOR USE in increasing the diameter of a driven pulley or flywheel on which a belt runs, the Rockwood Mfg. Co., 1801 English Ave., Indianapolis, Ind., has introduced a new fiber lagging which is applied to the pulley by means of an improved clamp. Increasing the diameter of the driven pulley permits increasing the size of the motor pulley, thus resulting in higher belt speed. Thus it is not necessary to operate with as high belt tension. Hence it is claimed that this practice results in increased belt life and lower belt maintenance.

A NEW LINE of repulsion-induction single-phase motors in sizes of from 1 to 3 hp., featuring electrical characteristics said to be desirable for such equipment as air compressors, viscous liquid pumps, and conveyors, has recently been announced by the Wagner Electric Corp., St. Louis, Mo. These Type RG motors have been designed for high starting torque, low starting current, high power factor and high efficiency.

ESPECIALLY for use in oil refineries and pipe line work, is a new oil-proof flax packing recently announced by the Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill. This packing is made from a long, continuous flax yarn so processed that each fiber is metallized, graphitized and impregnated with a special oil- and gasoline-proof binder compound. Processed chains of flax fibers are then braided and interlocked into commercial sizes from ¼ to 2 in. The lubricant used this packing is said to be permanent, neither melting nor dissolving out in service.

Pointer Type Thermometer

WHAT IS SAID to be the first industrial application of the "Coil-Within-Coil" design of bimetallic thermometer recently developed by the Weston Electrical Instrument Corp., Newark, N. J., has recently been announced by that company. The temperature element is incased within a stainless steel stem. A circular dial case, 3 in. in diameter, is mounted at right angles to and at the top of the stem. Owing to the method of constructing the bimetallic coil in double form, the instrument is said to be unaffected by gradual loss of its original high accuracy.

Pressure Controller

FOR CONTROLLING pressure in systems which otherwise would employ a chain-connected balanced valve and hydraulic cylinder, the Mason-Neilan Regulator Co., 1190 Adams St., Boston, Mass., has developed the new Syncromaster pressure controller which is a simplified, hydraulic-operated combination of pilot mechanism and diaphragm actuated control valve. Any source of hydraulic pressure from 20 to 150 lb. can be used. Since the pilot bleeds only when the control valve diaphragm pressure is reduced, water consumption is said to be extremely low. The controlled pressure is piped to a diaphragm, balanced by the setting of springs. Increase or decrease in the controlled pressure moves a piston valve to increase or decrease the pressure on the control valve diaphragm and thus change the valve opening.

Projection Heater

NEW PRINCIPLES in unit heater design are incorporated in a line of single- and multiple-projection heaters announced by the Trane Co., La Crosse, Wis. The single type heater consists of a two-row circular coil mounted between two circular plates. Fins attached to the coils supply extended heating surface. A motor and propeller fan placed within this assembly serve to draw air through the radiating section and project it downward toward the floor of the space to be warmed. Somewhat similar construction is used in the multiple type, except that the unit is rectangular and employs two motors and fans to draw air through a continuous coil of several turns.

Portable Rotary Pump

LIQUID of practically any viscosity can be handled in a new portable pumping unit offered in capacities of 10 and 20 g.p.m. by the Blackmer Pump Co., Grand Rapids, Mich. This pump, utilizing the familiar Blackmer bucket design of rotary pumping unit, may be equipped either with a V-belt drive or silent chain drive and is supplied either with or without castors for portability. It is operable from the nearest light socket.

MANUFACTURERS' LATEST PUBLICATIONS

Air Filters. Independent Air Filter Co., 228 North La Salle St., Chicago, Ill.—Bulletin K-120—8 pages on this company's dry fabric type air filters with renewable filter elements.

Alloys. International Nickel Co., 67 Wall St., New York City—26-page book on Monel, nickel and Inconel, with tabulated list of 400 practical applications for these alloys under corrosive conditions.

Blowers. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1911—12 pages on single-stage turbo-blowers in a variety of models, describing construction in considerable detail.

Blowers. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 21-B-19—8 pages, with engineering data, covering the rotary positive blowers made by this company; also accessories.

Cable. Anaconda Wire & Cable Co., 25 Broadway, New York City—Publication C-41—36 pages listing physical and electrical properties and describing and showing applications of this company's varnished cambric cable.

Chemicals. American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City—32-page book on this company's wetting agents, listing many technical data on properties and giving formulas for many applications.

Chemicals. Hercules Powder Co., Wilmington, Del.—32-page booklet on Hercules chlorinated rubber, with information on properties and a variety of uses.

Chemicals. Rohm & Haas Co., Inc., 222 West Washington Square, Philadelphia, Pa.—39-page book on Triton W-30, a wetting agent, with information regarding properties of this material and its performance principality in textiles.

Coatings. American Concrete & Steel Pipe Co., Box 1428 Arcade Station, Los Angeles, Calif.—8-page catalog describing Amercoat, a corrosion-resisting plastic coating for concrete, steel and wood.

Coatings. Wailes Dove-Hermiston Corp., New York City—"Bitumastic Visual Index," a 4-page folder indicating visually which product of this company is recommended for the protection and decoration of all paintable surfaces in and around a typical industrial plant.

Dust Collectors. American Air Filter Co., Louisville, Ky.—Bulletin 274—16 pages describing this company's Type W Roto-Clone dynamic dust precipitator, similar to earlier Roto-Clone designs except that it operates wet and sometimes in conjunction with a pre-cleaner.

Ejectors. Ingersoll-Rand Co., 11 Broadway, New York City—Bulletin 9046—28-page catalog describing this company's steam jet ejectors in detail; also condensers for use with ejectors.

Electrical Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Publications as follows: Bulletin 1190, 8 pages on switchboards; 2124A, totally inclosed, fan-cooled induction motors; 2289, distribution transformers.

Electrical Equipment. Diehl Manufacturing Co., Elizabeth, N. J.—12-page book describing this company's electric motors, generators and ventilating equipment; also 18-page catalog and price list with information covering dimensions, sizes and capacities of this equipment.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-67E, float switches for automatic pumping; GEA-1423A, solenoid-operated valves; GEA-1587C, magnetic switches for induction motors; GEA-1590C, oil-immersed magnetic switches for corrosive atmospheres; GEA-2011A, portable testing instruments; GEA-2473, push-but-

ton stations; GEA-2516, photo-electric relays; GEA-2635, recording electrical instruments.

Electrical Equipment. U. S. Electrical Motors, Inc., 200 East Slauson Ave., Los Angeles, Calif.—Two 4-page folders describing the method of producing asbestos insulated windings in this company's motors; and describing a type of semi-inclosure used with double-fan-cooled motors.

Equipment. Griscom-Russell Co., 285 Madison Ave., New York City—Bulletin 362—24-page book on feed water evaporators with information on construction, uses and heat balances; also Bulletin 915, 16 pages on shell-and-tube heat exchangers with tabular information on viscosity and specific gravity of petroleum products.

Equipment. Leader Iron Works, Decatur, Ill.—16-page book describing this company's facilities for fabricating large equipment and illustrating numerous examples of equipment produced. Includes charts for determining shell and head thickness for pressure vessels of various diameters for working pressures to 400 lb. per sq. in.

Equipment. Pioneer Alloy Products Co., 16601 Euclid Ave., Cleveland, Ohio—16-page catalog and price list covering acid-resisting alloy steel valves, pumps and heat and corrosion resisting castings made by this company.

Expansion Joints. E. B. Badger & Sons Co., Boston, Mass.—Bulletin 100—16 pages describing, illustrating and listing engineering data on this company's packless corrugated expansion joints in a variety of designs.

Furnaces. W. S. Rockwell Co., 50 Church St., New York City—Catalog 378—4 pages describing a variety of conveyor type furnaces.

Instruments. The Bristol Co., Waterbury, Conn.—Bulletin 507—Covers this company's complete line of round-chart Pyromaster potentiometers, including recorders, indicators and air-operated and electric-operated controllers.

Instruments. The Brown Instrument Co., Philadelphia, Pa.—Folder 80-36—Briefly explains advantages of using flowmeters; Catalog 6502, 28 pages on humidity instruments including hygrometers and psychrometers for recording and controlling.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 238—8 pages describing a system for regulating power load, developed at the Crown Willamette Paper Co., Camas, Wash.

Instruments. The Foxboro Co., Foxboro, Mass.—Vol. 1, No. 1, of a new "News Bulletin," describing features and applications of this company's industrial instruments.

Instruments. The Meriam Co., 1955 West 112th St., Cleveland, Ohio—50-page booklet, "The Manometer and Its Uses," describing this instrument in its numerous variations and uses. Gives conversion tables for various fluids, instructions for installation, and data on measuring open flow of gas wells. Also gives basic equations.

Instruments. Struthers Dunn, Inc., 139 North Juniper St., Philadelphia, Pa.—Bulletin B—New technical catalog covering thermostats, timers and relays, made by this company.

Insulators. American Lava Corp., Chattanooga, Tenn.—Chart listing physical, chemical and electrical characteristics of a variety of ceramic insulating materials offered by this company.

Lubrication. Bijur Lubricating Corp., Long Island City, N. Y.—12-page book illustrating the principle and a variety of applications of this company's automatic lubricating system.

Materials Handling. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1829-A—8 pages on small electric hoists for mines.

Materials Handling. Mathews Conveyor Co., Ellwood City, Pa.—32-page book, "Equipping Industry for Continuous Production," describing largely in pictures typical industrial applications of 17 types of conveying equipment produced by this company.

Materials Handling. Sprout, Waldron & Co., Muncy, Pa.—Catalog 1900—56 pages on bucket elevators, accessory equipment and a variety of other materials handling equipment offered by this company.

Mixers. Eastern Engineering Co., New Haven, Conn.—12 pages describing and giving sizes of a variety of portable mixers offered by this company.

Mixers. Patterson Foundry & Machine Co., East Liverpool, Ohio—8 pages portraying the wide variety of mixing equipment produced by this company.

Ovens. The Gehnrich Corp., Stillman Ave. and 35th St., Long Island City, N. Y.—Bulletin 106—12 pages with descriptions and dimension data covering a variety of gas heated, drying and heat treating ovens for industrial use.

Packing. Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill.—4-page folder describing a new conical self-aligning packing gland for ammonia, air and gas compressors, and reciprocating pumps and engines.

Plastics. Bakelite Corp., 247 Park Ave., New York City—48-page booklet illustrating and describing a wide variety of applications for Bakelite laminated products.

Power Transmission. Baldwin-Duckworth Chain Corp., Springfield, Mass.—8-page booklet describing chain-type flexible couplings made by this company.

Power Transmission. Carlyle Johnson Machine Co., Manchester, Conn.—10 pages describing a variety of friction clutches made by this company.

Pumps. DeLaval Steam Turbine Co., Trenton, N. J.—16-page booklet illustrating a wide variety of centrifugal and displacement pumps for all purposes.

Pumps. Goulds Pumps, Inc., Seneca Falls, N. Y.—Bulletin 210—8 pages of engineering data and description covering single-stage, ball-bearing centrifugal pumps.

Refractories. Quigley Co., 56 West 45th St., New York City—Bulletin 328—8 pages on savings effected with this company's insulating firebrick; also Bulletin 322-B, 4 pages on a neutral base refractory cement for furnace construction and maintenance.

Refractories. Refractory and Insulation Corp., 381 Fourth Ave., New York City—4-page folder describing this company's three refractory cements for monolithic construction.

Roofing. U. S. Steel Corp. Subsidiaries, 434 Fifth Ave., Pittsburgh, Pa.—Folder describing this company's new StormSeal galvanized roofing.

Rust Prevention. The Flood Co., 6217 Carnegie Ave., Cleveland, Ohio—8 pages discussing rust and its prevention, with particular reference to the use of this company's vehicle, Penetrol; also leaflet describing Penetrol and its use in aluminum paint and as a thinner.

Safety. American Optical Co., Southbridge, Mass.—Folder featuring a chart recommending types of safety goggles for protection against a variety of eye hazards in all principal industries.

Safety. The Beryllium Corp. of Pennsylvania, Reading, Pa.—4-page folder illustrating and listing sizes and weights of a variety of beryllium-copper non-sparking safety tools supplied by this company.

Safety. Mine Safety Appliances Co., Braddock, Thomas and Meade Sts., Pittsburgh, Pa.—8-page booklet, "Eye Protection," describing a variety of eye protective equipment including goggles, spectacles, helmets, etc., for use in all industries.

Separators. Stearns Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 92-B—Describes Class A and Junior Type B spout magnets for removing tramp iron from granular products.

Settlers. Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.—Book 1642—24 pages describing this company's Circuline collector for removing sludge in round settling tanks.

Steel. U. S. Steel Corp. Subsidiaries, Box 176, 434 Fifth Ave., Pittsburgh, Pa.—16-page booklet on copper bearing steels with information on properties.

Steel. Joseph T. Ryerson & Son, Inc., Chicago, Ill.—28-page 11x15 in. plastic-bound book, discussing this company's methods of selecting specified steels, testing and sending complete data with each order regarding heat treatment; describes types of steels regularly stocked, giving suggestions for heat treaters. Beautifully illustrated.

Stills. Barnstead Still & Sterilizer Co., Forest Hills, Boston, Mass.—70-page catalog covering in detail water distilling equipment and accessories, storage tanks and controls, with data on sizes and capacities of stills ranging from laboratory to large industrial size.

Strainers. Sheffler-Gross Co., Drexel Bldg., Philadelphia, Pa.—4-page folder describing Duoflo suction and discharge strainers for industrial oil-burning equipment.

Tanks. Atlantic Tank Corp., 235 Tonnele Ave., North Bergen, N. J.—36 pages on wooden tanks in a large variety of designs, with capacity tables and information on fittings.

Tanks. R. D. Cole Mfg. Co., Newnan, Ga.—New edition of this company's "Tank Talk," showing illustrations of numerous tank installations of all sizes.

Traps. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Bulletin T-1733—12 pages describing in detail this company's impulse steam trap, with information on construction and performance.

Tubes. Steel & Tubes, Inc., Cleveland, Ohio—Revised handbook on welded steel tubing, published by Formed Steel Tube Institute, 60 pages describing manufacture, mill practices, tolerances and specifications, and listing properties.

Valves. Hancock Valve Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn.—8 pages describing and listing prices and dimensions of a variety of bronze "500 Brinell" valves.

Valves. Hancock Valve Division, Manning-Maxwell & Moore, Inc., Bridgeport, Conn.—Bulletin 8500—4 pages describing this company's new blow-off valve equipped with a type of seat said practically to eliminate repair costs.

Ventilation. South Bend Air Products, Inc., South Bend, Ind.—Catalog 1A—15-page book describing and giving engineering data on a variety of propeller type ventilating fans and accessories made by this company.

Ventilators. The Swartwout Co., 18511 Euclid Ave., Cleveland, Ohio—Catalog Section B, Bulletin 205—18-page booklet on this company's rotary ball bearing ventilator with information on performance and on wind velocities and data facilitating capacity estimates.

Water Treatment. D. W. Haering & Co., 3408 Monroe St., Chicago, Ill.—16-page second edition of this company's booklet on organic methods of scale and corrosion control, with reference to the application of glucoside derivatives.

Wire. United States Rubber Products, Inc., Mechanical Goods Division, 1790 Broadway, New York City—Illustrated manual on wire entitled "U. S. Royal Cords and Cables," dealing with comparative tests, specifications and other information on industrial wire and cable of many types.

Wood. The Wood Preserving Corp., Koppers Bldg., Pittsburgh, Pa.—20-page booklet on treatment of timber for preservation against insect attack and decay.

Chemical Engineering NEWS

NEW YORK STUDENT CHAPTERS OF A.I.CH.E. HOLD ANNUAL MEETING

The second annual convention of student chapters of the American Institute of Chemical Engineers in the New York City area was held on March 25 and 26. The program for the first day included a luncheon at which over one hundred students were guests of the chapter at the College of the City of New York, which arranged the entire meeting. Students from New York University, Columbia, Newark College of Engineering, Brooklyn Polytechnic Institute, Yale, Princeton, Drexel Institute, Pennsylvania and the College of the City of New York attended. The luncheon was followed by inspection trips to several industrial chemical plants and a smoker at which the main speaker was Dr. John R. M. Klotz, who gave an entertaining account of his experiences in the chemical industry.

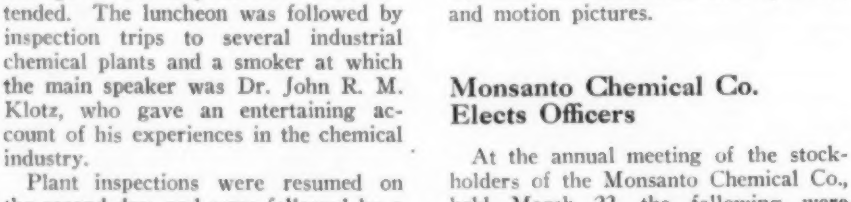
Plant inspections were resumed on the second day, and were followed by a contest sponsored by the New York Section of the American Institute of Chemical Engineers at which John P. Hubbell, chairman of the section, presided. The judges were A. M. Taylor, Louis Weisberg and James A. Lee. Cash prizes given for the presentation of original papers on chemical engineering subjects were won by W. P. Whitlock, III, of Princeton, and I. Rosenblum of the College of the City of New York. The convention concluded with a banquet held at the Chemists' club, at which Dr. H. C. Parmelee spoke on his recent trip to the pitchblende mines of the El Dorado Gold Mines, Inc., on the shores of Great Bear Lake in Northern Canada. The talk was well illustrated by slides and motion pictures.

Monsanto Chemical Co. Elects Officers

At the annual meeting of the stockholders of the Monsanto Chemical Co., held March 22, the following were elected members of the board of directors for the ensuing year: Edgar M. Queeny, J. W. Livingston, Charles Belknap, Theodore Rassieur, Gaston Du Bois, G. Lee Camp, and Walter W. Smith, all of St. Louis; William M. Rand of Everett, Mass.; L. F. Nickell of London, England, and John C. Brooks of Springfield, Mass.

At the meeting of the board of directors the present officers of the company were re-elected and in addition John C. Brooks of Springfield, Mass., was elected a vice-president. The list of officers is as follows: Edgar M. Queeny, president; Charles Belknap, executive vice-president; Gaston Du Bois, G. Lee Camp, John W. Livingston, William M. Rand, Russell John Hawn, and John C. Brooks, vice-presidents; Victor E. Williams, J. A. Berninghaus, L. F. Nickell, Lynn A. Watt, Osborne Bezanson, Harvey M. Harker, and Daniel S. Dinsmoor, assistant vice-presidents; Samuel W. Allender, assistant to president; W. W. Schneider, secretary; J. R. Mares and Charles E. Caspari, Jr., assistant secretaries; Daniel M. Sheehan, comptroller; E. J. Cunningham, J. W. Ludwig, and William I. Warren, assistant comptrollers; Fred A. Ulmer, treasurer; Stephen Louis and J. F. Martin, assistant treasurers.

Judges deciding student paper contest for A. I. Ch. E. in New York: Louis Weisberg, James A. Lee, and A. M. Taylor



Permanent Research in Iron Alloys Urged

Establishment of research in iron alloys on a permanent basis is urged by the Iron Alloys Committee of the Engineering Foundation in a report covering eight years of investigation in this field. The task has been financed by seventy-one manufacturers and engineering societies with total contributions of $237,852.

"Work so far accomplished by alloys of iron research has shown clearly that metallurgical research to date has been insufficient to clear up all uncertainties in our knowledge of alloy steels and cast irons," the committee, headed by George B. Waterhouse, professor of metallurgy at the Massachusetts Institute of Technology, declares.

The committee recommends the endowment of fellowships to undertake the acquisition of new knowledge of alloy steels and cast irons in those gaps which the committee's work has disclosed in the knowledge of ferrous alloy systems. A survey is suggested of all colleges where metallurgy research is carried on with a view to setting up fellowships in these institutions.

The committee reports that the 17,000 abstracts have been made from 6,000 reports published all over the world between 1890 and 1937. These are filed under twenty-one classifications on twelve important alloys, and on twenty-seven other elements which are occasionally encountered in iron and steel, including six gaseous compounds and three classes of impurities.

Plans Completed for A.I.Ch.E. Semi-Annual Meeting

Plans announced for the thirtieth semi-annual meeting of the American Institute of Chemical Engineers, which will be held at White Sulphur Springs, W. Va., May 9-11, include four important technical sessions as well as plant visits to chemical industries in Covington, Va. and Charleston, W. Va. Unusual entertainment features provided by the Greenbrier Hotel management, and interesting side trips through the surrounding country promise to make this one of the most attractive programs ever offered by the Institute. With the exception of the Roanoke, Va., meeting in December, 1933, this is the first time in 10 years that a convention has been held in this area which has become so important to chemical industry.

On Tuesday, May 10, optional plant visits are provided to either the large works of the West Virginia Pulp & Paper Co. or those of the Industrial Rayon Co. at Covington, Va. A special committee headed by J. N. Compton has arranged for a post-convention trip on Thursday to Charleston, W. Va., where visits have been tentatively scheduled to the following plants: Westvaco Chlorine Products, Inc., J. C. Dickenson Salt Co., sheet glass plant of Libbey-Owens-Ford, bottle plant of Owens-Illinois Glass Co. and the Elk Refining Co.

Technical sessions start Monday morning with a paper on the "Chemical and Industrial Development of the Kanawha River Valley" by Ellis T. Crawford, Jr. and J. N. Compton of the Carbide and Carbon Chemicals Corp. Prof. A. B. Newman will discuss the history and present status of chemical engineering education in the United States. The session will be concluded with a paper on the "Full-Scale Production of "Calcium Metaphosphate at Wilson Dam" by Curtis, Abrams, Copson and Junkins of the TVA chemical engineering department.

Two papers on filtration data by Profs. Charles F. Bonilla of Johns Hopkins, and E. L. McMillen and H. A. Webber of Iowa State are scheduled for Tuesday morning. Max Jakob of Armour Institute follows with a paper on catalytic conversions. Herman W. Mahr of the duPont Dye Works at Wilmington, Del., will discuss "Economic Life and Catalysis Costs in Contact Catalysis." H. F. Johnstone of the University of Illinois and R. V. Kleinschmidt of Arthur D. Little, Inc., conclude the session with a discussion of the absorption of gases in wet cyclone scrubbers.

On Wednesday morning two papers from Ohio State University by Withrow, Herndon and Koffolt, deal with the mitigation of trade wastes and graphical methods for the control of factory solutions. L. W. Bass, assistant director of Mellon Institute, describes: "The Application of the Material Balance to the Cost Control of Manufacturing Operations." Dr. L. V. Burton, editor of *Food Industries*, will discuss the opportunities for chemical engineers in the new field of food engineering. Concluding paper in the morning session will deal with the transportation and utilization of light hydrocarbons by S. D. Turner and A. C. Rubey of Humble Oil & Refining Co.

E. H. Smoker of the United Gas Improvement Co., Philadelphia, will discuss the determination of plates in fractionating columns on Wednesday afternoon. He will be followed by Prof. C. C. Furnas of Yale, and F. Bellinger of the Hercules Powder Co. on "Operating Characteristics of Packed Columns."

This panoramic view of The Greenbrier Hotel at White Sulphur Springs, West Virginia was taken from a shoulder of Greenbrier Mountain, 2000 feet above the resort where on May 9–11 members of the American Institute of Chemical Engineers will meet for their annual convention

Research Work Planned to Develop Magnesium Supply

The subcommittee on fertilizer reaction of the committee on fertilizers, American Society of Agronomy, of which Dr. F. W. Parker is chairman, has arranged for comprehensive experiments to be conducted during the coming season, looking toward the development of a satisfactory method of determining the availability of magnesium in various magnesium-containing materials when used as constituents of complete fertilizers. The Division of Soil Fertility will conduct an experiment on three or four representative soils from Maine, Long Island, New Jersey, and the Eastern Shore of Maryland or Virginia, and the North Carolina Experiment Station will conduct an experiment on four representative soils from that State. The soils will represent the types on which magnesium deficiency is most frequently observed.

Engineers Will Discuss Air Conditioning

Mechanical and refrigerating engineers in Metropolitan New York will meet April 28 at 8 P.M. in the Engineering Societies Building, 29 West 39 Street, to discuss air conditioning and dehumidification. S. C. Coey of the Research Corp. will discuss liquid absorption systems and J. C. Patterson of the Carrier Corporation will speak on solid absorption. Clyde R. Place, consulting engineer is chairman of this joint meeting of the Process Industries Division of A.S.M.E. and the New York section of the A.S.R.E.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

PROCESS industry watching Washington finds two problems of about equal importance these days. International questions are for some divisions of industry most important. But for others the question of a "dictator" is of greater long-range concern affecting costs. And this concern has nothing to do wtih partisan politics. It is solely a matter of the fundamental philosophy of government which will prevail.

Washington is now convinced that many of the problems of industry which it has been considering as domestic, are in fact largely influenced by international affairs. But as yet the Administration has not adopted a policy of making decisions for American consumption with full attention to foreign factors. However, there appears to be some fortunate trend in that direction. It is difficult to say, however, whether tariff revision by the State Department, tax revision in Congress, and the other actions at the Capitol and in the White House will give as much weight to these factors politically as they inevitably must have economically.

Congress is Pro-business

The new tax bill with which the Senate is struggling in an effort to give business relief, without too much loss to the Treasury, shows how far the members of Congress have gone in their desire to aid business. There is no doubt but that the present depression condition (recession is not the word any more) will force far more relief into the tax bill than the President will like. Except for tactical reasons it is not important to most industries whether the undistributed profits tax is repealed or only much modified. The effect is going to be that next year process industry may, if it wishes, withhold a large part of its earnings without too heavy a tax penalty.

Wage and hour standards if fixed at all will represent very conservative limits on industries' payrolls. Most of chemical-process industry will not be affected at all, because the limits which Washington dares set now will be much less burdensome than present going wage and hour practices.

Most of the rest of the legislation of technical importance remains in a very uncertain status as April opens. It is almost impossible to guess, even Congressional leaders do not know, what will happen to: Stream pollution, food and drug legislation, restriction on "monopoly" patents, and the rest of the controversial regulatory bills which are so near enactment that they could readily be pushed through if the leaders so desire.

Of some comfort to business is the high position on the legislative calendar of the plan to *lend* the country out of depression instead of the old pump-priming *spend* method. There is no doubt that many long-term loans to industry will be recognized, probably by simple expansion of R.F.C. banking powers. But the long-trend influence is still inflationary.

T.V.A. Investigation

A broad and thorough investigation of Tennessee Valley Authority is assured by the form in which Congress phrased its resolution of inquiry. Of special interest to the chemical industries will be the questions of purchase of phosphate lands, possible cost of synthetic Chilean nitrate at Muscle Shoals, and the critical inquiry regarding the basis on which power has been sold to big chemical firms for electrochemical and electro-metallurgical processing.

It is not expected that the "scandals" which will undoubtedly be disclosed will prove very fundamental. Of much greater importance for the 8-months inquiry will be the arguments and findings regarding the proper scope of governmental effort in business affairs. The way in which the inquiry is conducted, and the influence on public opinion which it has will probably be much more important to industry than the mere scope or character of any formal recommendations which the joint committee of 10 may reach and present to Congress next January.

The character of Congress at that date, determined by elections later in 1938, will be an important factor in fixing the policy of government in business for the next decade. The investigation is, therefore, of vastly greater significance than anything which has to do with power, fertilizers, or even "yardstick" making.

Compulsory licensing of patents will be recommended to the House by the special Sub-Committee which held hearings on this subject in March, according to preliminary conclusions. The radical bill for this purpose will not pass this year, however. But if Congress has the same anti-monopoly ideas next year, as this, some important legislation restricting patents may be expected in 1939.

Silver can usefully be employed for the lining of food and other containers, concludes the Bureau of Standards. Advocates argue that this metal at $6 per pound avoirdupois is not too expensive for many uses for which it has never been considered. It ought to be an important material for equipment construction, promoters argue.

Helium is now offered by the Bureau of Mines under new regulations which set it up with virtual monopoly as a full pledged business institution. The Bureau has taken over the subsidiary helium activities of Girdler by purchase at about one-half million dollars. Navy and Bureau men hope for the recommended three million dollar dirigible which will be the principal customer, if authorized by Congress.

"Collusive bidding" on cement has resulted in the President's authorization of a new cement buying plan. The Procurement Division of the Treasury Department is asking for bids on a f.o.b. plant basis for three million barrels. This will be supplied, not only to Government agencies doing building, but also to contracters who may wish to take it for jobs which they are building under Government contract.

Manufacturing Chemists Association did not make a persuasive case before the I.C.C. when it requested that pressed-in closures of drums be forbidden. In an unusual argumentative opinion this request is denied. Either welded or pressed-in closures may, therefore, be used as in the past. Political arguments, as well as technical considerations, were presented, and are said to have influenced the decision materially.

Alcohol for motor fuel will be the subject of a special report of the Bureau of Chemistry and Soils scheduled for mid-April. Unless Bureau officials have radically changed their opinion they will not want to be put into this part of the alky gas business. Legislation on this subject is not expected this year; but some of the Regional Laboratory work of the Bureau, authorized by the Farm Act of 1938, may have to go for alky studies. Thus far the location and scope of work of these four regional laboratories have not been announced.

Food and Drug Legislation is held up by two strictly chemical controversies. The alcohol industry still battles against the requirement limiting whiskey to "grain" alcohol, and the battle over licensing of new drugs to prevent another sulfanilimide elixir tragedy is heated.

CONTROL OF AUSTRIA ADDS TO GERMANY'S RAW MATERIAL SUPPLY

From Our German Correspondent

WHILE adding to Germany's food and raw material problem in some respects, the absorption of Austria by the German Reich will help ease Germany's shortage in certain materials, notably timber and iron ore. The demand for wood has increased rapidly as a result of new uses in recent years. Austria's extensive forests, covering 37 per cent of the country and equaling one-third of the Reich's forest territory, will be a welcome addition to Germany's supply. The other addition to the Four-Year-Plan economy will be one million tons of high grade iron ore which Austria will be able to contribute over and above her own needs. This by no means solves Germany's iron problem since Germany had to import 20 million tons of ore in 1937, chiefly from Sweden, Morocco, and Spain. Marshal Göring, head of the Four-Year-Plan, has announced ambitious plans to increase the output of Austrian mines and oil wells and to develop new mineral resources. This project will supplement Germany's efforts to develop low-grade ores, through which the domestic output was boosted from 1.3 million tons in 1932 to 8 million tons in 1937. One of Germany's biggest industrial enterprises created last year by the government, the Hermann Göring Company, has already started operations in the Salzgitter area. This company and other West German concerns are attempting to produce none too profitable ores, using the Renn smelting process developed by Krupp and Röchling process for treating silicic ores developed by Hermann Röchling in the Saar district.

Another rare material contributed by Austria will be some beryllium, now being developed by Austrian and American interests. Germany's chemical industry will also be benefitted by the addition of Austria's magnesite supply. Austria enjoys a semi-monopoly of this comparatively rare mineral, and produces twice as much as her only rival in the field, the United States.

Because of Austria's favorable geographical location in relation to Balkan markets, it is conceivable that existing Austrian chemical plants will be reorganized and expanded. Employing about 16,000 workers, the Austrian chemical industry has operated far below capacity in recent years, chiefly because it could not meet the competition of Germany, Switzerland and Czechoslovakia. Before the "Auschluss", in fact, Germany was supplying 50 to 70 per cent of Austria's chemical imports.

During the past two years Austrian chemical concerns, in which considerable foreign capital was invested, established new plants, among them a phosphoric acid plant by Skoda-Werke-Wetzler A.G. in Moosierbaum, a plant for resin, tar, asphalt roofing, and insulating materials by "Teerag" at Linz, and synthetic nitrogenous plants by Swiss-controlled Hydronitro S.A., and German I. G. Farben and Dynamit Nobel. Projected plants will produce sugar and byproducts from wood (a pilot plant is already in operation in Reichraming); casein staple fiber by the Italian Lanital process, and artificial wool according to German and Austrian processes in a plant in Vienna Neustadt.

A chemical sidelight in the strained political relations between the German Reich and Czechoslovakia is the fact that during the past two years many unemployed German chemists belonging to the Sudetic German minority in Czechoslovakia and unable to find employment in their own country, have come to the Reich to work for German chemical concerns, where the demand for trained specialists cannot be filled. The increasing space devoted in German chemical trade publications to advertisements of concerns seeking trained chemists, shows that the shortage has not abated. Recently there has also been a noticeable increase in the classified section of these publications of Reich and Sudetic Germans offering their services as sales representatives for Reich German chemical concerns in Czechoslovakia.

Germany's economic penetration of the Danubian basin is reflected in trade statistics with Hungary. Germany now leads Austria as Hungary's chief trade partner and her exports to Hungary of machinery, instruments, automobiles, coal products, textiles, and chemicals, have shown an unusual rise since 1933. Hungary, on the other hand, has exported more agricultural products and raw materials to Germany. Whereas German aluminum producers formerly procured much ore from France, they are now securing bauxite from Hungary in increasing quantities. In 1936, 33,000 of the 34,200 carloads of bauxite exported from Hungary went to Germany. Since 1935 Hungary has undertaken its own production of aluminum metal under the Söderberg process in the plant of Manfred Weiss in Csepel. It is reported that this company has developed a successful new process for a non-oxidizing aluminum alloy. American interests are also said to be negotiating for the erection of a new aluminum producing plant in Hungary.

Lines of hose laid to combat fire at Polytechnic Institute of Brooklyn last month give indication of the tons of water pumped into the building. The fire was largely confined to the fifth floor but the chemical laboratories directly beneath suffered considerable damage from water

Four Symposia Arranged for Electrochemist Meeting

The Electrochemical Society will hold its Spring Meeting at Savannah, Georgia, April 27-30. In recent years there have been increased applications of physico-chemical methods in the processing of pulp and an ever-increasing quantity of electrochemical products are being consumed in the many pulp and paper mills. In response to a cordial invitation from Dr. Charles H. Herty, the Society is meeting jointly with paper experts to review and discuss old and new problems with which the industry is confronted. Contributions to the session scheduled for Thursday morning, April 28, at the Hotel DeSoto, have come in from world-wide authorities, and Dr. Charles Carpenter of the Pulp and Paper Laboratory at Savannah will preside over the symposium. Among those participating in the discussion will be Louis E. Wise of the New York State College of Forestry; H. M. Spurlin of the Hercules Powder Co.; Frank C. Vilbrandt and L. E. Ward, Jr., of Virginia Polytechnic Institute; James A. Lee, of *Chemical and Metallurgical Engineering*, and a member of the Council of the Technical Association of the Pulp and Paper Industry; John D. Rue of the Hooker Electrochemical Co.; Umberto Pomilio of Rome, Italy; Louis E. Lovett of Cleveland Heights, Ohio; and C. G. Albert of Edgar Brothers Co., Metuchen, N. J.

A second symposium will be devoted to industrial applications of electro-osmotic phenomena. Included in this category are reports on studies made by Ian Kemp of Birmingham, England; S. Komagata of Tokyo, Japan; Carl E. Curtis of Dayton, Ohio; and L. S. Moyer of the University of Minnesota. Prof. H. Jermain Creighton of Swarthmore College will preside.

A third session will be devoted to the electrodeposition of metals. Prof. E. M. Baker of the University of Michigan will preside. The metals to be discussed are manganese, chromium, zinc, copper, nickel, and alloys of copper and of nickel.

A fourth session will be presided over by Prof. C. J. Brockman of the University of Georgia. This session will be devoted to principles of electrochemistry, including papers on the dropping mercury electrode, pH determination, a new differential dynamometer, motor-electrolytic potentials, film potentials, and over-voltage.

There will be three Division luncheons: At the first, Dr. P. H. Brace of the Westinghouse company will preside and Dr. J. N. Carothers of the Monsanto Chemical Co. will discuss "Electric Furnace Phosphates"; the second luncheon will be under the direction of the Electrodeposition Division, Dr. E. M. Baker presiding, and D. H. Bissell of the Chromium Corp. of America will present an illustrated talk on "Chromium Plating for the Paper Industry"; and the third luncheon, Saturday, will be presided over by Dr. J. W. Marden of the Westinghouse Lamp Co., and will be under the auspices of the Electronics Division. The speaker will be Dr. R. H. George of Purdue University who will discuss "Applications of the Cathode Ray Tube."

Social features include visits to the plants of the Southern Cotton Oil Co., the Union Bag and Paper Corp., Dr. Herty's Pulp and Paper Laboratory, the Reliance Fertilizer Co., and the Savannah Sugar Refinery. Prizes and awards will be presented at the annual banquet of the Society on Friday evening, April 29 and the newly elected officers of the Society will be introduced.

Bulk Packaging Discussed At Chicago

Under the sponsorship of the American Management Association, the second annual conference on packaging, packing, and shipping was held at the Palmer House, Chicago an March 22-25. As an added feature there was an exposition of packing machinery and equipment and leading companies in the container field had samples of their products on exhibition.

On the two final days of the conference, sessions on bulk packaging were given prominence with R. W. Lahey of the American Cyanamid Co. presiding. Mr. Lahey pointed out that the conference served the dual purpose of placing information and data of a technical character before factory managers and packaging men so as to help them in selecting the proper type of container and to give manufacturers of containers a better knowledge of shippers problems so that research and development in production ends may keep pace with the changing phases of shippers' requirements. He stated that 1937 had shown more changes and improvements in the bulk container field than had been attained in any preceding year. He credited shippers with initiating the greater part of the improvements.

T. P. Callahan, Monsanto Chemical Co., Everett, Mass., delivered a practical address on loading and staying wooden barrels and steel drums. He discussed the different methods of loading and called attention to the savings effected by proper loading. He pointed out that while carriers pay substantial sums each year in settlement of claims, such payments represent only a small fraction of the economic loss that results to industry from damage to freight.

High-Test Molasses for Alcohol Production

New economic factors affecting molasses and alcohol, and perhaps some other related chemical business, are a byproduct of sugar control. The full impact of these changes has probably not yet been felt, but the shift to high-test molasses is already notable.

To escape from the limits of sugar quotas imposed by A.A.A., Cuban cane growers had to find a new outlet for some of their production, or starve. They chose to process the surplus cane juice into a strong invert-sugar sirup. The result is so-called high test molasses, containing up to 75 per cent or 80 per cent sugar, practically all invert sugar, with very little sucrose. The record of the imports of sugar from Cuba during the last seven years illustrate the extent to which this trend has raised the sugar content of imported molasses. The following are official data.

Year	Gallons Imported (Millions)	Sugar Content: Millions of Pounds	Sugar Content: Lb. per Gallon
1931	109	645	6.0
1932	94	595	6.3
1933	113	715	6.3
1934	133	845	6.4
1935	177	1,157	6.6
1936	184	1,293	7.0
1937	237	1,740	7.3

During the same period the molasses imported from other regions, particularly Puerto Rico, did not materially change in sugar content, ranging from 6.0 to 6.2 for the entire period. Incidentally, the alcohol yield figures at refineries using molasses as raw material show the secondary effect. Recent average yields of alcohol were substantially higher, between 15 and 20 per cent above a typical 2½ gallons of molasses per gallon of alcohol made.

Question has been raised as to the tariff and the agricultural significance of this change. Actually neither such effect seems important. Duty is imposed on imported sugar-containing sirups according to the weight of contained sugar, assuming that the material is not to be used for a human food.

Agricultural control measures are also not significantly involved. It makes little difference to the Department of Agriculture whether a low-grade or high-grade molasses is employed. The important thing is that other domestic agricultural materials probably would not be used anyway. And so long as this plan of super-quota sugar utilization continues, there is always the reserve sugar growing capacity on which America could draw in the event of shortage. This is much better than to have the quota system completely eliminate the cane growers, who then might be very much missed if there should unexpectedly be a sugar shortage some year.

PERSONALITIES

✦ Charles Lucius Allen, chairman of the board of the Norton Co., was honored on March 6 with a bronze medal commemorating his 80th birthday and his 53rd year of activity in the abrasives industry. While still in high school he became associated with F. B. Norton in 1873 and was made general manager of the Norton Co. when it was formed in 1885. He has since served continuously as one of its executive officers.

✦ J. W. Turrentine, president of the American Potash Institute, Inc., Washington, D. C., has been awarded the gold medal of the Academie d' Agriculture de France for the collaboration of the Institute in the preparation of the book, "Potash Efficiency Symptoms."

✦ R. H. Maples, formerly division engineer for Cities Service Oil Co., in East Texas, has joined the staff of the American Petroleum Institute's production division, as staff engineer assigned to the Dallas office.

✦ K. G. Mackenzie of the Texas Co. will serve as 1938 chairman of the American Petroleum Institute's committee on testing methods and specifications.

✦ J. Bennett Hill of the Sun Oil Co., Marcus Hook, Pa., has been appointed chairman of the 1938 program committee of the refining division of the American Petroleum Institute.

✦ Gerald Wendt, president of the American Institute, is head of the advisory committee on science of the New York World's Fair. The duty of the committee is to coordinate the exhibits from the standpoint of science and to insure as far as possible the complete presentation of science.

✦ H. O. Chute, stalwart supporter of chemical engineering's choicest traditions, was honored recently with a testimonial dinner given by members of the New York Chemists' Club.

✦ Abraham White, assistant professor of physiological chemistry at Yale University, has been awarded the Eli Lilly prize in biological chemistry for 1938. Dr. White was honored for his work on sulphur metabolism and protein hormones.

✦ H. W. Gillett, chief technical adviser of Battelle Memorial Institute, Columbus, Ohio, has been chosen to deliver the 1939 Howe memorial lecture of the American Institute of Mining and Metallurgical Engineers.

✦ Sterling Temple, director of the R. & H. Chemicals Department of E. I. du Pont de Nemours & Co., at Niagara Falls, N. Y., has received the Jacob F. Schoellkopf Medal of the Western New York Section, American Chemical Society, in recognition of his work in chemical research.

✦ Maynard M. Baldwin, formerly research assistant at the Mineral Industries Experiment Station, Pennsylvania State College, is now a member of the chemical staff of Battelle Memorial Institute, Columbus, Ohio, and has been assigned to fundamental research on organo-metallic compounds.

✦ Joseph A. Pask has been appointed staff assistant in the department of ceramic engineering at the University of Illinois. Mr. Pask was formerly in charge of control and development for the Willamina Clay Products Co., Willamina, Ore.

✦ Theodore P. Walker has been elected to succeed the late William D. Ticknor as president of the Commercial Solvents Corp. Major Walker joined the organization in 1922, three years after its founding, and since 1928 has held the office of executive vice-president.

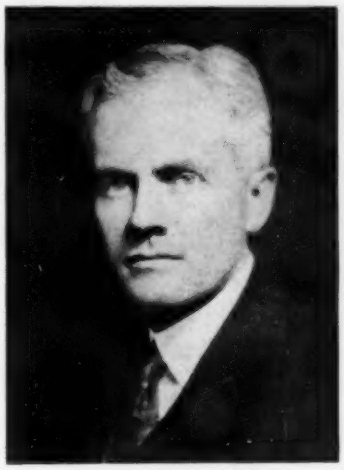
✦ J. E. Hatfield, formerly storage battery engineer with Eagle-Picher Lead Co., is now with Willard Storage Battery Co., Cleveland, Ohio, in the development laboratory division.

✦ J. J. Vetter has been made vice-president and director of research of Natural Products Refinery Co., Jersey City, N. J.

✦ F. W. Godwin has been appointed to the chemical engineering staff of Armour Institute of Technology, Chicago. Dr. Godwin is also director of the Institute's coal research laboratory.

✦ Charles E. Hartford has been appointed chief chemist of the Southern Kraft Corp., Panama City, Fla.

✦ William Roberts, Iowa State chemical engineer, has been transferred from the Des Moines, Iowa, plant of the F. W. Fitch Co. to become superintendent of that company's new plant at Bayonne, N. J.



Paul D. Merica

✦ Paul D. Merica, vice-president of the International Nickel Co., has received the John Fritz Medal in recognition of "his important contributions to the development of alloys for industrial uses." This medal is awarded jointly by the A.I.M.E., A.S.C.E., A.I.E.E., and A.S.M.E., and is considered to be the highest honor in the engineering profession. Dr. Merica shares with Marconi the distinction of being the youngest person to receive it.

✦ James F. Adams has been elected head of the John A. Manning Paper Co. of Troy, N. Y. to fill the vacancy caused by the death of Mr. Manning. Mr. Adams was formerly with the Aluminum Co. of America and the Behr-Manning Corp.

✦ Ralph H. Luebbers has been added to the teaching staff of the department of chemical engineering at the University of Missouri, Columbia, Mo.

✦ L. L. Davis, Continental Oil Co., Ponca City, Okla., has been named chairman of the American Petroleum Institute's 1938 committee on corrosion of refinery equipment.

✦ Wheeler McMillen, president of the National Farm Chemurgic Council and editorial director of *Country Home*, succeeds the late Francis P. Garvan as a director of the Chemical Foundation.

✦ William D. Ticknor, president and chairman of the board of the Commercial Solvents Corp., died March 24 at his home in Englewood, N. J. Mr. Ticknor was also a director of Corn Products Refining Co., the B. F. Goodrich Co., and American Machine and Metals.

Chemical ECONOMICS and MARKETS

CONSUMPTION OF CHEMICALS SHOWS LESS THAN SEASONAL GAINS

According to the preliminary index for manufacturing production as compiled by the Federal Reserve System, there was a slight uplift in February over the rate established in January the index numbers being 76 and 75 respectively. The adjusted indexes for manufactures, however, were 75 for February and 76 for January which indicates that the usual seasonal influences were lacking in February. Commodity stocks of manufactured goods at the close of February were represented by an index of 157 as against a revised index of 162 for the preceding month. Stocks of chemicals and allied products increased from an index comparison of 180 for the end of January to 189 for the end of February but some of the commodities included in the allied group destroys the usefulness of this comparison if applied to chemicals proper.

Progress throughout March was again far from seasonal and was of a spotty character whether applied to manufacturing in general or to production of chemicals in particular. Petroleum refining stands out among the industries which has a record for the first quarter of surpassing the operating rate of the corresponding quarter last year. In fact oil refining for the first quarter established an industry record for that period with an estimated run to stills more than 25 per cent above the 1937 quarter total.

Manufacturers sales for February declined 22 per cent from the value reported for February 1937 and were 1.4 per cent higher than those for January 1938 according to reports from manufacturers cooperating in the monthly joint study of the National Association of Credit Men and the Bureau of Foreign and Domestic Commerce. For the Chemical and Allied Products group declines from February 1937 and January 1938 were given as 22.2 per cent and 2.6 per cent respectively but the number of reporting companies was but 44 which may impair the accuracy of the percentage changes shown if they are to be applied to the entire industry.

The movement of commodities for the second quarter of this year, based on carload expectations of the Thirteen Shippers' Advisory Boards, indicates a drop of 17.7 per cent from the actual carloadings in the second quarter of last year. Of the 29 commodity groups considered, 23 are expected to share in the decline with six groups promising to exceed the 1937 totals. The six groups, however, include cottonseed products, fruits, vegetables, and live stock.

The National Association of Purchasing Agents reports that inventories being slowly worked down are prolonging the time when marked quickening in buying volume will occur for current operating schedules. Plants throughout the country are running at least part time and supplies are being consumed; in fact, inventories are reduced in some lines of trade to such extent that it would not take much improvement in demand to strengthen the price structure. However, supplies are still burdensome in numerous instances of both raw materials and finished goods, and the declining rate of production retards the general movement toward consumption of stocks on hand. Moreover, there are few companies who will extend their commitments until every last ounce of material is off the shelves or out of the bins and liquidation of last year's extensive purchases fully completed.

The glass industry showed some gains in output in March for the glassware and container branches but flat glass production continued at a low rate. The outlook for fertilizer consumption has improved as the season advanced and earlier estimates of a 25 to 30 per cent decline have been revised to a 15 per cent basis. Stocks of silk in warehouse at the beginning of April were lower than at this time last year and mill takings in March were 34,884 bales which was considerably better than had been anticipated. Woolen mills responded to a falling off in demand for their products early in 1937 by restricting mill operations. As a result, stocks of finished goods at mills is relatively light and reductions in inventories held by distributors would be quickly reflected in increased mill activities. Sales of paint, varnish and lacquer in February carried a value of $1,656,976 hence the Jan.-Feb. total amounted to $42,901,615 compared with $59,951,223 for the first two months of 1937 or a decline of close to 40 per cent for the 1938 period.

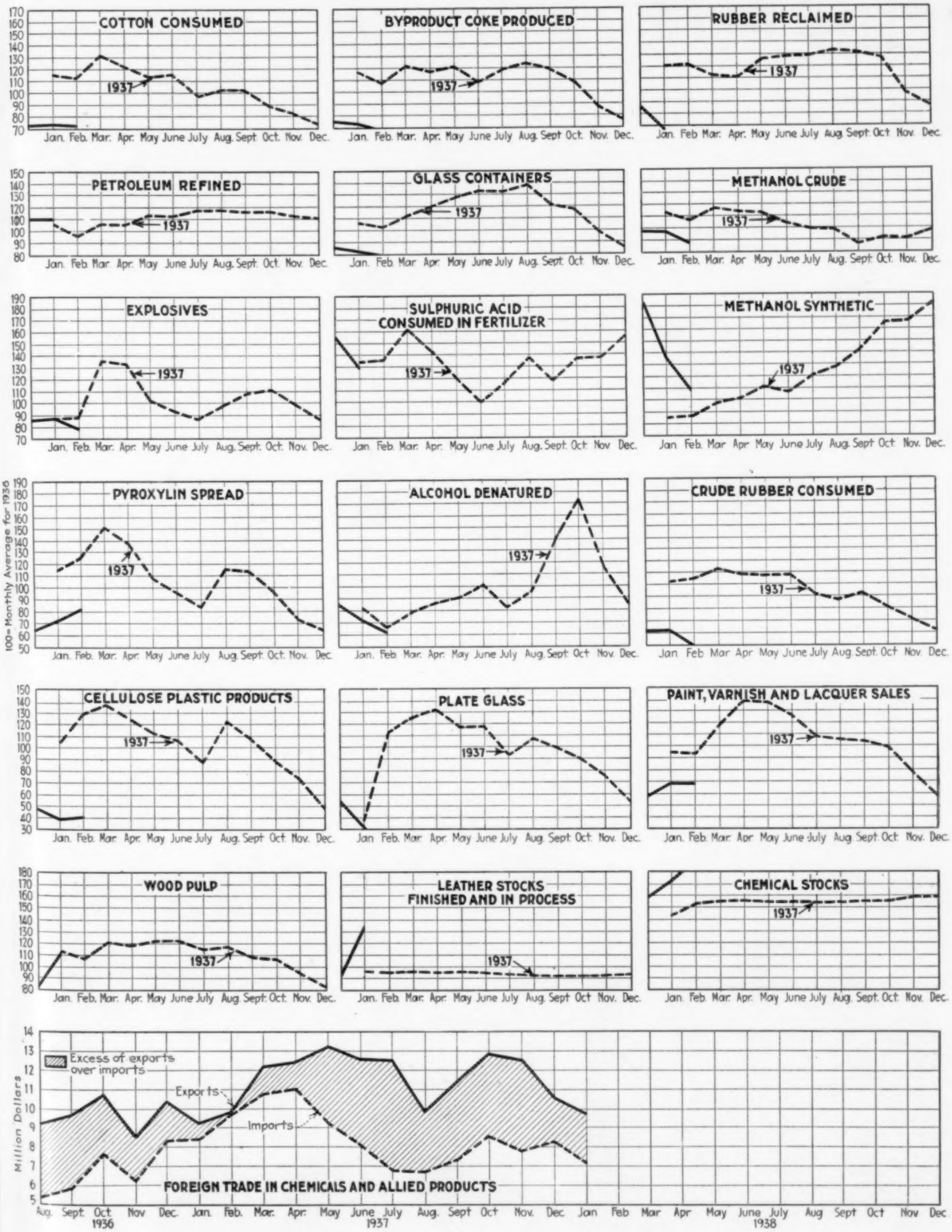
Fertilizer sales this year, as indicated by the sale of tax tags in January and February, have held up well, particularly larly in view of the decline in prices of farm products, a prospective shrinkage in farm income, and uncertainty over operation of the Farm Bill according to the National Fertilizer Association. Total tag sales in 17 States in February, according to reports by State control officials were 759,813 tons, a decline of 6 per cent from February 1937. It compared very favorably with earlier years, being 33 per cent above 1936.

Production and Consumption Data for Chemical-Consuming Industries

PRODUCTION	Feb. 1938	Feb. 1937	Jan.-Feb. 1938	Jan.-Feb. 1937	Per Cent of Declin for 1938e
Alcohol, ethyl, 1,000 pr. gal	16,708	17,572	32,556	36,276	10.3
Alcohol, denatured, 1,000 wi. gal	5,087	5,475	10,970	12,282	10.8
Ammonia, 1,000 lb.[1]	79,762	127,722	169,236	267,118	36.6
Automobiles, No	186,806	363,995	397,256	744,050	46.6
Benzol, 1,000 gal	5,575	9,522	11,730	19,891	41.0
Byproduct coke, 1,000 tons	2,494	3,991	5,256	8,349	37.1
Glass containers, 1,000 gr	2,995	3,880	6,120	7,919	22.7
Plate glass, 1,000 sq. ft	2,664	18,676	7,783	25,049	68.9
Methanol, crude, gal	404,970	500,685	863,317	1,025,755	15.8
Methanol, synthetic, gal	2,290,609	1,849,302	5,187,503	3,685,117	40.8*
Nitrocellulose plastics, 1,000 lb	675	1,976	1,321	3,691	64.2
Cellulose acetate plastice, 1,000 lb	338	1,270	682	2,123	67.9
Pyroxylin spread, 1,000 lb	4,259	6,498	7,895	12,463	36.7
Rosin, wood, bbl	48,161	58,068	91,389	118,688	23.0
Turpentine, wood, bbl	7,141	7,666	14,097	18,684	24.5
Rubber reclaimed, ton	6,012	15,129	13,479	30,321	55.5
Steel barrels, heavy, No	529,566	718,319	1,072,535	1,638,983	34.6
Steel barrels, light, No	144,330	180,042	300,994	356,837	15.6
CONSUMPTION					
Cotton, 1,000 bales	428	666	862	1,344	35.8
Silk, bales	30,260	38,484	60,975	82,682	26.3
Wool, 1,000 lb	16,072	38,565	32,453	80,181	59.5
Explosives, 1,000 lb	24,607	28,273	52,361	56,167	6.8
Rubber, crude, ton	23,868	50,282	53,297	101,100	47.3

[1] Sulphate equivalent at byproduct coke plants. * Per cent of increase.

PRODUCTION AND CONSUMPTION TRENDS



CHEMICAL PRICES MOVE DOWNWARD UNDER RESTRICTED BUYING INTEREST

THE chemical industry entered the second quarter of the year with prospects for some broadening in consuming demand but with trading in March failing to hold any substantial increase over that for the preceding month. Larger call for agricultural and insecticide chemicals was reported and moderate gains were recorded for some of the heavy chemicals including, chlorine, alkalis and sulphuric acid. The nearby outlook is clouded with only moderate improvement anticipated but considerable sentiment is found in favor of a marked pick-up from August forward.

The price tone for chemicals remains firm even though some selections sold at lower levels and the weighted index number was reduced. Generally speaking, the industry entered the year with production costs higher than they were a year ago and unit costs have increased because producing plants have been operating at a lower percentage of capacity. As a result the greater part of chemical offerings have been held at unchanged levels. Where price changes have occurred, however, the movement usually has been downward. Prices for denatured alcohol were marked down a month ago and the lower price level has since been in effect. Calcium chloride producers have announced a lower price schedule for that product. Spirits of turpentine closed under last month's figure and some of the other solvents have shown an easy price tone as a result of competitive conditions. Cream of tartar, tartaric acid, and tartarates moved up in the price scale.

Vegetable oils and animal fats were in a weak position throughout the period. Lower prices extended practically throughout the list with offerings of foreign-made oils joining the general trend.

When the Commodity Credit Corp. announced that it was sponsoring a program whereby a fund of $7,000,000 would be made available for loans to the naval stores industry, prices for turpentine and rosin started on an upward trend but it was short lived and lack of buying interest started another downward movement. The loans are to be operated through the American Turpentine Farmers Association which has a membership of 80 per cent of producers. The loans are to be made on a basis of 26c. a gal. for turpentine and $5.75 a bbl. for medium grade rosin. The conditions imposed require producers to contribute 65c. per bbl. of turpentine and rosin either in cash or as an addition to amount of loan. Loans are limited to 150,000 naval stores units, start April 1, may run for 10 months, and bear interest at the rate of 4 per cent. With this financing it is hoped that producers can withhold stocks from the market during the early part of the naval stores year as ordinarily about 70 per cent of production occurs from April 1 to Sept. 30 and heavy receipts at terminals in that period are a menace to price stability.

The National Association of Insecticide and Disinfectant Manufacturers, Inc., has been working with the Bureau of Standards with a view toward setting up commercial standards for certain disinfectants and insecticides. Following several group meetings, specifications have been drawn up and approved by the Federal Food and Drug Administration to establish trade standards for liquid hypochlorite disinfectant, pine oil disinfectant, coal-tar disinfectant-emulsifying type—cresylic disinfectants, and household insecticides—liquid spray type.

Under date of March 19, the Federal Trade Commission promulgated trade practice rules for the carbon dioxide manufacturing industry. Following a general trade practice conference, the proposed rules were made available to the industry for suggestions and objections if any. After further consideration final action was taken and the rules were approved by the commission.

A succession of Mexican incidents, culminating in the expropriation of the petroleum industry by President Cardenas, has spotlighted the problem of any process industry which has foreign subsidiaries or depends on foreign raw materials.

The Mexican situation would be bad enough in itself, if it were not well established that the Japanese were taking advantage of this set-up to press their desire for iron ore reserves and a port (with unannounced naval-base characteristics) on the West Coast of Mexico, and also are offering to take charge of some of the petroleum properties which occidental countries must surrender. Nicaragua is finding it difficult to make its way, and has cancelled its special tariff concessions to the United States, which included a number of chemical interest. Brazil now demands Brazilian ownership and control of enterprises within their territory.

The export of scrap metals of deficiency nature is being opposed by the Bureau of Mines, but the export of iron and steel, especially low-grade scrap, is to be encouraged, the Bureau argues. No clear trend develops out of the whole mess, except that international affairs are more important than ever. Meantime, the War Department would like to give some educational orders to those who would supply military necessities in time of emergency. Chemical enterprises which think they could well participate by being educated on a small scale at a time when they can afford the factory space and attention for this, ought to press this matter in Washington, or it will go by the board for another year.

Production of superphosphate declined somewhat more than seasonally from January to February according to reports by acidulators. Compared with February of last year there was a decline of 22 per cent, with production showing a much larger drop in the Southern Area than in the North. Production in the first eight months of the current fiscal year, from July through February, was 6 per cent larger than in the corresponding period of last year. The increase over last year has been getting progressively smaller, and it is likely to disappear altogether by June. Production in the South is already under last year as a result of the sharp February decline, following a small drop in January.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1935

This month	100.36
Last month	101.11
April, 1937	101.28
April, 1936	98.86

Lower prices for solvents including denatured ethyl alcohol and spirits of turpentine were prominent in causing a decline in the weighted index number. Tin salts also were lower in price.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1935

This month	80.66
Last month	84.70
April, 1937	125.85
April, 1936	95.06

Price declines were fairly general throughout the list of oils and animal fats. Imported oils including China wood, coconut, and olive oil foots joined in the general price trend.

Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.05½-$0.06½	$0.05½-$0.06½	$0.07 -$0 08
Acid, acetic, 28%, bbl., cwt	2.23 - 2.48	2.23 - 2.48	2.45 - 2.70
Glacial 99%, drums	8.43 - 8.68	8.43 - 8.68	8.43 - 8.68
U. S. P. reagent	10.25 -10.50	10.25 -10.50	10.52 -10.77
Boric, bbl., ton	105.00-115.00	105.00-115.00	105.00-115.00
Citric, kegs, lb	.24 - .27	.24 - .27	.25 - .28
Formic, bbl., ton	.10½- .11	.10½- .11	.11 - .11½
Gallic, tech., bbl., lb	.75 - .78	.75 - .78	.60 - .65
Hydrofluoric 30% carb., lb	.07 - .07½	.07 - .07½	.07 - .07½
Lactic, 44%, tech., light, bbl., lb.	.06¼- .06½	.06¼- .06½	.6¼ - .6½
Muriatic, 18°, tanks, cwt	1.05 -......	1.05 -...	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb	.10½- .12	.10½- .12	.10½- .12
Phosphoric, tech., c'bys., lb	.09 - .10	.09 - .10	.09 - .10
Sulphuric, 60°, tanks, ton	13.00 -......	13.00 -......	11.00 -11.50
Sulphuric, 66°, tanks, ton	16.50 -......	16.50 -......	15.50 -......
Tannic, tech., bbl., lb	.40 - .45	.40 - .45	.26 - .30
Tartaric, powd., bbl., lb	.25½- .26	.24½- .25½	.22½- .23
Tungstic, bbl., lb	2.75 -......	2.75 -......	2.50 - 2.75
Alcohol, Amyl	......-......	......-......	......-......
From Pentane, tanks, lb	.123-......	.123-......	.123-......
Alcohol, Butyl, tanks, lb	.08½-......	.08½-......	.08½-......
Alcohol, Ethyl, 190p'f., bbl., gal.	4.11 -......	4.14 -......	4.14 -......
Denatured, 190 proof			
No. 1 special, dr., gal wks	.31 -......	.31 -......	.32 -......
Alum, ammonia, lump, bbl., lb	.03½- .04	.03½- .04	.03 - .04
Potash, lump, bbl., lb	.03½- .04	.03½- .04	.03 - .04
Aluminum sulphate, com bags cwt.	1.35 - 1.50	1.35 - 1.50	1.35 - 1.50
Iron free, bg., cwt	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Aqua ammonia, 26°, drums, lb	.02½- .03	.02½- .03	.02½- .03
tanks, lb	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb	.15½-......	.15½-......	.15½- .16
tanks, lb	.04½-......	.04½-......	.04½-......
Ammonium carbonate, powd tech., casks, lb	.08 - .12	.08 - .12	.08 - .12
Sulphate, wks., cwt	1.475-......	1.475-......	1.35 -......
Amylacetate tech., tanks, lb	.11 - .12	.11½- .12	.11 - .11½
Antimony Oxide, bbl., lb	.12½- .13	.12½- .13	.16 - .16½
Arsenic, white, powd., bbl., lb	.03 - .03½	.03 - .03½	.03 - .03½
Red, powd., kegs, lb	.15½- .16	.15½- .16	.15½- .16
Barium carbonate, bbl., ton	52.50 -57.50	52.50 -57.50	56.50 -58.00
Chloride, bbl., ton	79.00 -81.00	79.00 -81.00	72.00 -74.00
Nitrate, cask, lb	.07 - .08	.07 - .08	.08½- .09
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f. o b., wks., drums, cwt	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	46.00 -51.00	46.00 -51.00	44.00 -49.00
Bromine, cs., lb	.30 - .32	.30 - .32	.36 - .38
Calcium acetate, bags	1.65 -......	1.65 -......	2.10 -......
Arsenate, dr., lb	.06½- .07	.06½- .07	.06½- .07
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., del., ton	21.50 -24.50	21.50 -24.50	20.00 -33.00
flake, dr., del., ton	23.00 -25.00	23.00 -25.00	22.00 -35.00
Phosphate, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05½- .06
Tetrachloride drums, lb	.05½- .08½	.05½- .06	.05½- .06
Chlorine, liquid, tanks, wks., lb	2.15 -......	2.15 -......	2.15 -......
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb	1.67 - 1.70	1.67 - 1.70	1.41 - 1.51
Copperas, bgs., f.o.b., wks., ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Copper carbonate, bbl., lb	.09 - .16½	.09 - .16½	.11½- 16
Sulphate, bbl., cwt	4 25 - 4.50	4.25 - 4.50	6.00 - 6 25
Cream of tartar, bbl., lb	.20½- .21	.19½- .20	.15½- -.16
Diethylene glycol, dr., lb	.22 - .23	.22 - .23	.22 - .23
Epsom salt, dom., tech., bbl., cwt.	1.80 - 2.00	1.80 - 2.00	1.80- 2.00
Ethyl acetate, drums, lb	.06½-......	.06½-......	.07 -......
Formaldehyde, 40%, bbl., lb	.05½- .06½	.05½- .06½	.05½- .6½
Furfural, dr., lb	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, ref. drums, lb	.16 - .18	.16 - .18	.16 - .18
Glaubers salt, bags, cwt	.95 - 1.00	.95 - 1.00	.85 - 1.00
Glycerine, c.p., drums, extra, lb	.15½-......	.15½-......	.31 -.....
Lead:			
White, basic carbonate, dry casks, lb	.06½-......	.06½-......	.07½-......
White, basic sulphate, sck., lb	.05½-......	.05½- .07½	.08½-......
Red, dry, sck, lb	.07 -......	.07 - .08½	.10 -......
Lead acetate, white crys., bbl., lb.	.11 - .12	.11 - .12	.13½- 14
Lead arsenate, powd., bbl., lb	.13 - .13½	.13 - .13½	.10½- .11
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk., lb	.06 -	.06 -......	.09 -......
Lithophone, bags, lb	.04½- .04½	.04½- .04½	.04½- .05
Magnesium carb., tech., bags, lb	.06 - .06½	.06 - .06½	.06 - .06½

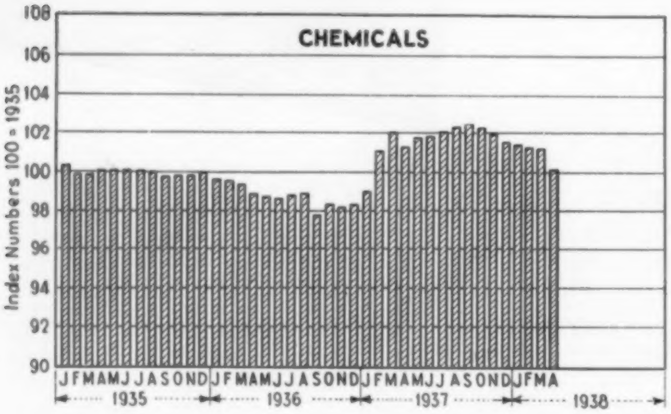
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to April 13

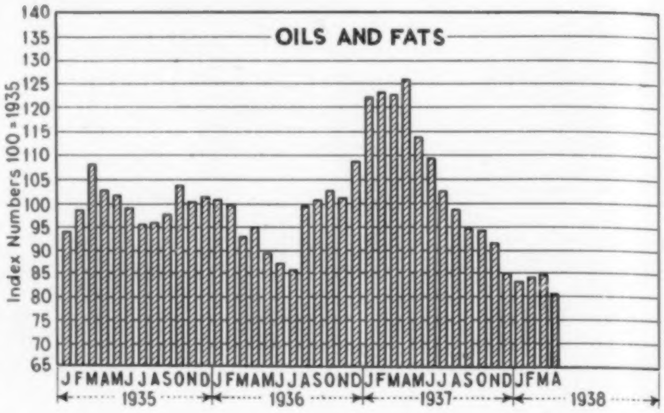
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.31 -......	.31 -......	.33 -......
97%, tanks, gal	.32 -......	.32 -......	.34 -......
Synthetic, tanks, gal	.33 -......	.33 -......	.33 -......
Nickel salt, double, bbl., lb	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb	.10 -......	.10 -......	.11½-......
Phosphorus, red, cases, lb	.40 - .42	.40 - .42	.40 - .42
Yellow, cases, lb	.24 - .30	.24 - .30	.24 - .30
Potassium bichromate, casks, lb	.08½- .09	.08½- .09	.08½- .09
Carbonate, 80-85%, calc. csk., lb	.06½-......	.06½-......	.07 - .07½
Chlorate, powd., lb	.09½-......	.09½- .09	.08½- .09
Hydroxide (c'stic potash) dr., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Muriate, 80% bgs., ton	23.00 -......	23.00 -......	23.00 -......
Nitrate, bbl. lb	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb	.18½- .19	.18½- .19	.18½- 19
Prussiate, yellow, casks, lb	.15 - .16	.15 - .16	.15 - .16
Sal ammoniac, white, casks, lb	.05 - .05½	.05 - .05½	.05 - .05½
Salsoda, bbl., cwt	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt	1.23 -......	1.23 -......	1.23 -......
Dense, bags, cwt	1.25 -......	1.25 -......	1.25 -......
Soda, caustic, 76%, solid, drums, contract, cwt	2.60 - 3.00	2.60 - 3.00	2.60 - 3.00
Acetate, works, bbl., lb	.04 - .05	.04½- .05	.04½- .05
Bicarbonate, bbl., cwt	1.75 - 2.00	1.75 - 2.00	1.75 - 2.00
Bichromate, casks, lb	.06½- .07	.06½- .07	.06½- .07
Bisulphate, bulk, ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Bisulphite, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb	.06½- .06½	.06½- .06½	.06½- .06½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.75
Cyanide, cases, dom., lb	.16½- .17	.16½- .17	.16½- .17
Fluoride, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., cwt	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt	2.20 - 3.20	2.20 - 3.20	2.15 - 3.15
Nitrate, bags, cwt	1.45 -......	1.45 -......	1.375-......
Nitrite, casks, lb	.07 - .08	.07 - .08	.07½- .08
Phosphate, dibasic, bags, lb	1.85 -......	1.85 -......	.022- .024
Prussiate, yel. drums, lb	.10 - .11	.10- .11	.10 - .11
Silicate (40° dr.) wks., cwt	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.02½- .03
Sulphite, cyrs., bbl., lb	.02½- .02½	.02½- .02½	.02½- .02½
Sulphur, crude at mine, bulk, ton.	18.00 -......	18.00 -......	18.00- ......
Chloride, dr., lb	.03 - .04	.03 - .04	.03½- .04
Dioxide, cyl., lb	.07 - .08	.06½- .08	.07 - .07½
Flour, bag, cwt	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb	.46 -.. ..	.47 -......	58 -......
Crystals, bbl., lb	.32½-......	.33½-......	.42½-......
Zinc. chloride, gran., bbl., lb	.05 - .06	.05 - .06	.05 - .06
Carbonate, bbl., lb	.14 - .15	.14 - .15	.09 - .11
Cyanide, dr., lb	.36 - .38	.36 - .38	36 - .38
Dust, bbl., lb	.06½-......	.06½-......	.094-......
Zinc oxide, lead free, bag., lb	.06½-......	.06½-......	05½
5% lead sulphate, bags, lb	.06½-......	.06½-......	.05½-......
Sulphate, bbl., cwt	3.15 - 3.60	3.15 - 3.60	3.30 - 4.50

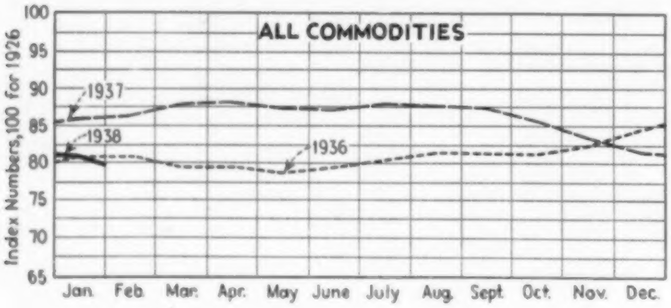
OILS AND FATS

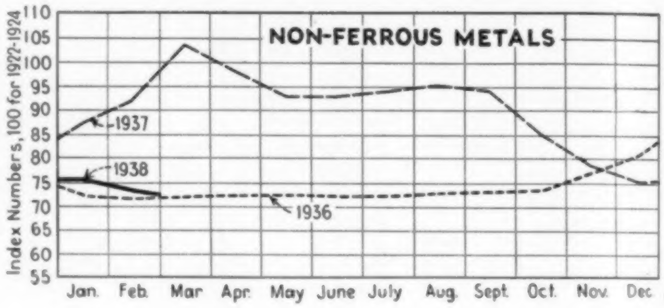
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb	$0.09½-$0.10	$0 09 -$0 10	$0 10½ $0 11
Chinawood oil, bbl., lb	.12½-......	.14 -......	.15½-......
Coconut oil, Ceylon, tanks, N. Y. lb	.03½-......	.03½-......	.08½-......
Corn oil crude, tanks (f.o.b. mill), lb	.07½-......	.07½......	.10½-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.07 -......	.07 -......	.09½-......
Linseed oil, raw car lots, bbl., lb	.093-......	.097-......	.113-......
Palm, casks, lb	.04 -......	.07 -......	06½
Peanut oil, crude, tanks (mill), lb.	.07½-......	.07½-......	.10½-......
Rapeseed oil, refined, bbl., gal	.88 -......	.90 -......	.90 -......
Soya bean, tank, lb	.06 -......	.06½-......	.10 -......
Sulphur (olive foots), bbl., lb	.08½-......	.09 -......	.12 -......
Cod, Newfoundland, bbl., gal	.5	52 -	.51 -..
Menhaden, light pressed, bbl., lb	.087	.087-......	088
Crude, tanks (f.o.b. factory), gal.	.35 -......	.37½-......	.45 -......
Grease, yellow, loose, lb	.04½-......	.04½-......	.08½-......
Oleo stearine, lb	.07½-......	07½-......	10½-......
Oleo oil, No. 1	.08½-......	.09-......	.15 -......
Red oil, distilled, d.p. bbl., lb	.09½-......	.09½-......	.10½-......
Tallow extra, loose, lb	.05½-......	.05½-......	.09 -......

CHEM. & MET.'S WEIGHTED PRICE INDEXES









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude, bbl., lb.	$0.52 –$0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline salts, bbl., lb.	.22 – .24	.22 – .24	.24 – .25
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	1.10 – 1.25
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.65 – .67
Benzoic acid, U.S.P., kgs., lb.	.54 – .56	.52 – .54	.52 – .54
Benzyl chloride, tech., dr., lb.	.25 – .27	.25 – .27	.25 – .27
Benzol, 90%, tanks, works, gal.	.16 – .18	.16 – .18	.16 – .18
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.12 – .13	.12 – .13	.10 – .11
Cresylic acid, 99%, dr., wks., gal.	.89 – .92	.89 – .92	.77 – .85
Diethylaniline, dr., lb.	.40 – .45	.40 – .45	.55 – .58
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluen, bbl., lb.	.15 – .16	.15 – .16	.16 – .17
Dip oil, 15%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.32 – .36	.32 – .36	.32 – .36
H-acid, bbl., lb.	.50 – .55	.50 – .55	.55 – .60
Naphthalene, flake, bbl., lb.	.06¾– .07	.07½– .07¾	.07½– .07¾
Nitrobenzene, dr., lb.	.08 – .09	.08 – .09	.08½– .10
Para-nitraniline, bbl., lb.	.50 – .52	.50 – .52	.45 – .47
Phenol, U.S.P., drums, lb.	.14½–......	.14½–......	.13½– .14
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.30 – .40
Pyridine, dr., gal.	1.55 – 1.60	1.55 – 1.60	1.10 – 1.15
Resorcinal, tech., kegs, lb.	.75 – .80	.75 – .80	.70 – .75
Salicylic acid, tech., bbl., lb.	.33 – .40	.33 – .40	.34 – .40
Solvent naptha, w.w., tanks, gal.	.30 –......	.30 –......	.26 –......
Tolidine, bbl., lb.	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal.	.35 –......	.35 –......	.30 –......
Xylene, com, tanks, gal.	.35 –......	.35 –......	.30 –......

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.07 – .12	.08½– .12	.16 – .18
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.02½– .30	.02½– .30	.04 – .30
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.37 – .38
Ultramarine blue, bbl., lb.	.10 – .26	.10 – .26	.10 – .26
Chrome green, bbl., lb.	.21 – .30	.21 – .30	.26 – .27
Carmine red, tins, lb.	4.00 – 4.40	4.00 – 4.40	4.00 – 4.40
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	1.45 – 1.50	1.45 – 1.50	1.72 – 1.75
Chrome yellow, C. P., bbl., lb.	.14½– .15½	.14½– .15½	.13 – .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 – .06½	.06 – .06½	.06 – .06½
Gum copal Congo, bags, lb.	.06 – .30	.08 – .30	.08 – .30
Manila, bags, lb.	.07 – .14	.08½– .14	.09 – .14
Damar, Batavia, cases, lb.	.16 – .24	.16 – .24	.15½– .16
Kauri cases, lb.	.17½– .60	.18½– .60	.19 – .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton.	50.00 –......	50.00 –......	50.00 –......
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .04	.03 – .04	.03 – .04
Rosin, H., bbl.	6.10 –......	6.40 –......	9.30 –......
Turpentine, gal.	.28½–......	.34½–......	.41 –......
Shellac, orange, fine, bags, lb.	.20 –......	.21 –......	.25 –......
Bleached, bonedry, bags, lb.	.16½–......	.17 –......	.21 –......
T. N. Bags, lb.	.11 –......	.11½–......	.14 –......
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 –......	13.75 –......	13.75 –......

INDUSTRIAL NOTES

F. J. Stokes Machine Co., Philadelphia, has enlarged the sales territory of its representative, The Williams Sales Co., Cincinnati, to include all of Ohio and Kentucky and part of Indiana. L. H. Butcher Co., Los Angeles, is now representative for all Stokes equipment for the entire West Coast.

Anchor Hocking Glass Corp., Lancaster, Ohio, has completed the merger and operating plans which consolidated the business of the Anchor Cap Corp. and The Hocking Glass Co. and subsidiaries.

Fairbanks, Morse & Co., Chicago, has opened a display room in its building at 600 S. Michigan Ave.

The Warner Chemical Co., New York, has appointed Kenneth R. Bivens as manager of its Chicago office.

Roots-Connersville Blower Corp., Connersville, Ind., has appointed as zone representatives for its turbine pumps, Herman L. Krouse, 4217 Buell Drive, Ft. Wayne, Ind. and The A. K. Howell Co., Syndicate Trust Bldg., St. Louis.

Quaker Chemical Products Corp., Conshohocken, Pa., has added George F. Ecker to its sales department and has appointed The Wittichen Chemical Co., Birmingham, Ala., as its sales representative in the southern states.

The Harry W. Dietert Co., Detroit, has entered the field of spectograph equipment and will maintain a laboratory to develop uses and to train consumer technicians in its operation.

Southern Alkali Corp., Corpus Christi, Texas is now operating its new chlorine unit and made the first shipment on March 14.

E. I. du Pont de Nemours & Co., Wilmington, will have an exhibit at the International Petroleum Exposition in Tulsa, May 14-21. The exhibit will show the contribution of chemicals to the petroleum industry.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1938	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$40,000	$635,000	$160,000	$120,000
Middle Atlantic	830,000	100,000	4,739,000	1,298,000
South	1,780,000	40,000	8,980,000	1,240,000
Middle West	635,000	40,000	10,505,000	3,240,000
West of Mississippi	4,390,000	40,000	7,345,000	4,460,000
Far West	700,000	500,000	830,000	2,032,000
Canada	8,460,000	630,000	10,605,000	670,000
Total	$16,835,000	$1,985,000	$43,164,000	$13,060,000

PROPOSED WORK

Cement Plant—Marquette Cement Mfg. Co., 140 South Dearborn St., Chicago, Ill., plans to construct a cement bulk plant at Vicksburg, Miss. Estimated cost will exceed $40,000.

Chemical Plant—Carbide & Carbon Chemical Corp., subsidiary of Union Carbide & Carbon Corp., 30 East 42nd Street, New York, N. Y., has purchased a site at Texas City, Tex., and plans to expand its plant. Preliminary surveys are now being made. Estimated cost of first unit $2,500,000; total estimate $4,000,000.

Chemical Plant—Coastal Chemical Co Harlingen, Tex., plans to construct a new plant to replace the one recently destroyed by fire.

Chemistry Building—The Bilhuber Knoel Corp., 154 Ogden St., Jersey City, N. J., will soon award the contract for a 3 story, 52x183 ft. chemistry building. The Ballinger Co., 12th and Chestnut Sts., Philadelphia, Pa., Archt.

Factory—Agfa Ansco Corp., Charles St., Binghamton, N. Y., will receive bids in May for the construction of a 4 story factory. Lockwood Greene Engineers, Inc., 30 Rockefeller Plaza, New York, Engrs. Estimated cost $150,000.

Factory—Cinecolor, Inc., 201 North Occidental Blvd., Los Angeles, Calif., W. Prynne, in charge of operations, is having plans prepared by Clarence J. Small, Archt., 309 South Orlando Ave., Los Angeles, for a 1 and part 2 story, 128x220 ft. film manufacturing plant at 2728 South Olive Ave., Burbank, Calif. Estimated cost $100,000.

Factory—General Plastics, Inc., Walck Rd., North Tonawanda, N. Y., is receiving bids for the construction of a factory. Estimated cost $500,000.

Factory—International Color & Printing Co., Peoria, Ill., contemplates repairs and alterations to its factory. Estimated cost will exceed $50,000.

Factory—Pomona Terra Cotta Co., Greensboro, N. C., plans to rebuild its brick making factory recently destroyed by fire. Estimated cost between $40,000 and $50,000.

Factory—West Coast Kalsomine Co., 5th and Grayson Sts., Berkeley, Calif., is receiving bids for the construction of a part 1, 2, 3 and 4 story, 160x220 ft. factory.

Feldspar Plant—Realty, Inc., Hendersonville, N. C., has purchased 190 acres of land from J. F. Elliott, Rutherford, N. C., and will construct a large feldspar finishing plant at Thermal City, near Gilkey, N. C.

Tile Factory—Krick Lyndall, Decatur, Ind., contemplates the construction of a tile mill to replace one recently destroyed by fire. Estimated cost $45,000. Maturity indefinite.

Glass Factory—Owner c/o J. G. Stewart, K.C., 7 Coburg Rd., Halifax, N. S., plans to construct a glass factory at New Glasgow, N. S. Estimated cost $40,000.

Laboratory—Socony Vacuum Oil Co., 26 Broadway, New York, N. Y., will soon award the contract for altering and constructing 2 story, 47x118 ft. addition to its laboratory, Paulsboro, N. J. Fred G. Frost, 144 East 30th St., New York, Archt. Estimated cost $100,000.

Nickel Refinery—International Nickel Co., 67 Wall St., New York, N. Y., plans to construct a refinery at Huntington, W. Va. Estimated cost $300,000.

Rayon Mill—S. M. Nottingham and John Graves, Gordonsville, Ga., contemplates the construction of a rayon mill at Gordonsville. Estimated cost $40,000.

Refinery—Ashland Oil & Refining Co., Ashland, Ky., plans to construct a new gasoline distillation plant and other improvements at its refinery. Estimated cost $750,000.

Refinery—Cosden Petroleum Co., Fort Worth and Big Spring, Tex., is having preliminary surveys made for an addition to its refinery at Big Spring, Tex. Estimated cost $250,000.

Refinery—Inland Empire Refineries, Inc., recently organized with W. H. McIntyre, Jr., Pres. Wasatch Oil Refining Co., McIntyre Bldg., Salt Lake City, Utah, and other Spokane parties, plans to construct an oil refinery at Spokane, Wash., to refine the oil from the Cutbank Oil Fields. Estimated cost $500,000.

Refinery—Owner, c/o C. H. Blackeny, M.L.A., Moncton, N. B., Can., has had plans prepared for shale development oil deposits and construction of reduction and refining plants in Albert Co. Estimated cost $1,000,000.

Oil Refinery—Salvage Oil & Fuel Co., Robinson, Ill., plans improvements to its refinery. Project will be financed from proceeds of a $500,000 stock issue.

Oil Refinery—Skelly Oil Co., 47th and Penn Sts., Kansas City, Mo., plans to construct a refinery and storage building at 4820 South Richmond St., Chicago, Ill. Estimated cost $100,000.

Paper Mill—Eddy Paper Corp., Three Rivers, Que., Can., plans improvements to its paper mill and power plant at White Pigeon, Mich. Estimated cost $300,000.

Pulp Mill—Owner, c/o H. K. Ferguson Co., Engr., 25 West 43rd St., New York, N. Y., plans to construct a finishing plant for paper pulp at Port Credit, Ont., Can. Estimated cost $2,000,000.

Pulp Mill—Owner, c/o H. K. Ferguson, engr., 25 West 43rd St., New York, N. Y., plans to construct a pulp mill at Elias, Ont., Can. Estimated cost $5,000,000.

Paper Mill—Thunder Bay Paper Mill Co., Ltd., Port Arthur, Ont., Can., will soon receive bids for the construction of improvements to its mill. Estimated cost $45,000. R. J. Askin, Port Arthur, Mgr.

Pulp Mill—Wilson Boxes, Ltd., Wall St., St. John, N. B., Can., is having plans prepared for the construction of a plant to manufacture wood pulp, etc., at Fairville, N. B. Machinery will be purchased. Estimated cost $75,000.

Sugar Refinery—J. Aron & Co., 416 Poydras St., New Orleans, La., contemplates rebuilding its Supreme Sugar Refinery at Napoleonville, La., recently destroyed by fire. Estimated cost $600,000.

Storage Building—Nashua River Paper Co., Pepperell, Mass., contemplates rebuilding its storage plant at Lowell and Groton Sts., Pepperell, Mass., recently destroyed by fire. Estimated cost will exceed $40,000. Maturity indefinite.

Warehouse—C. H. Ketchum, Archt., Clinton Sq. Bldg., Syracuse, N. Y., will soon receive bids for the construction of a warehouse for the Norwich Pharmacal Co., Norwich, N. Y. Estimated cost $40,000.

Potassium Ethyl Xanthate, etc.—Smith, Kirkpatrick & Co., Inc., 115 Broad St., New York, N. Y., is in the market for potassium ethyl xanthate and potassium amyl xanthate in 10 ton lots.

CONTRACTS AWARDED

Barking Plant—Brown Corporation, Ltd., 71 Peter St., Quebec City, Que., Can., has awarded the contract for a two drum barking plant at its pulp mill at LaTuque, Que., to Foundation Co., Ltd., 1538 Sherbrooke St., Montreal, Que. Estimated cost $130,000.

Electroplating Factory—Driscoll & Co., 842 Troy St., Chicago, Ill., has awarded the general contract for an addition to its electroplating factory to E. H. Peterson, 6133 West School St., Chicago. Estimated cost $40,000.

Paint Factory—Norfolk Paint & Varnish Co., Newport Ave., North Quincy, Mass., will alter its plant and equipment for varnish cooking unit. Work will be done by owner under separate contracts. Estimated cost $40,000.

Refinery—British American Oil Co., Ltd., 6590 Durocher St., Montreal, Que., Can., will construct an addition to its oil refinery here. Work will be done by separate contracts. Estimated cost $500,000.

Oil Refinery—Cities Service Oil Co., A. P. Frame in charge, 60 Wall St. Tower Bldg., New York, N. Y., has awarded the contract for alterations and additions to its refinery at East Braintree, Mass., to Alco Products Co., 30 Church St., New York, N. Y. Estimated cost $500,000.

Oil Refinery—Inland Empire Refineries, Inc., c/o D. S. Bennion, 1019 West Boone St., Spokane, Wash., plans to construct an oil refinery to manufacture gasoline and by-products. Estimated cost $500,000.

Refinery—Standard Oil Co. of New Jersey, 26 Bway., New York, N. Y., has awarded the contract for the construction of a plant for recovery and removal of hydrogen sulphide from refinery gases at Bayway, N. J., to Girdler Corp., 425 South 5th St., Louisville, Ky. Estimated cost including equipment $40,000.

Petroleum Refinery—Warren Petroleum Corp., Monument, N. M., will construct an addition to its petroleum refinery to have a capacity of 50,000 gal. Work will be done by separate contracts. Estimated cost will exceed $40,000.

Research Laboratory—John B. Pierce Foundation, 290 Congress St., New Haven, Conn., has awarded the contract for a 2 story, 30x35 ft. research laboratory to Mott-Mohr Construction Co., Inc., 440 Elm St., New Haven, Conn. Estimated cost will exceed $40,000.

Warehouse—Procter & Gamble Co., Cincinnati, O., has awarded the contract for a 2 story, 72x140 ft. warehouse at Marriott and Decatur Sts., Baltimore, Md., to Consolidated Engineering Co., 20 East Franklin St., Baltimore. Estimated cost $100,000.

Warehouse—United Distilleries, Amston, Conn., have awarded the contract for a 1 story, 100x140 ft. warehouse and office building to N. T. Semel, Inc., 1920 Harrison Ave., Bronx, N. Y. Estimated cost $55,000.

FACTORY CONSUMPTION OF OILS AND FATS MOVED UPWARD LAST YEAR

FACTORY consumption of animal and vegetable fats and oils has shown an unbroken annual increase from 1932 through 1937. The total for 1932 was reported by the Bureau of the Census at 3,355,555,000 lb. while factory consumption in 1937 reached a total of 4,993,914,000 lb. or a rise of about 48.8 per cent over the 1932 figure. From a volume standpoint, the edible trades accounted for the larger part of the increase in consumption. Relatively, however, manufacture of printing ink made the best showing, the percentage gain for consumption of oil being more than 151 per cent for 1937. Percentage gains for specified industries were 80 per cent for paint and varnish; 79 per cent for edible uses; 78.7 per cent for linoleum and oilcloth; and 7.3 per cent for soap—the comparison in each case being for 1937 and 1932.

In the accompanying table for consumption of oils and fats by classes of products, data for oleo stock were not collected, hence the secondary products, edible animal stearin and oleo oil, are included. For those oils which are consumed both in the crude and refined form, the net total was arrived at by deducting from the total of crude and refined consumed, the quantity of refined produced.

In view of the high prices asked for China wood oil at times in 1937 and with shipments from Chinese ports interrupted in the latter part of the year, a surprising increase in consumption of that oil was reported for last year. Of the total oils consumed in making paint and varnish last year China wood accounted for about 23 per cent and linseed for about 58 per cent. Consumption of perilla oil fell from 53,222,000 lb. in 1936 to 31,776,000 lb. in 1937 and the smaller amounts of this oil available in domestic markets evidently increased the relative importance of both China wood and linseed oils as in 1936 linseed oil represented less than 53 per cent of total oil consumption in paint and varnish and China wood oil, less than 21.5 per cent. Oiticica oil is not specifically mentioned and evidently is included in the total of 1,498,000 lb. under the heading "Other Vegetable Oils" consumed in the paint and varnish industry. Babassu oil which is attaining a more important position—not only in volume but also because the nuts are being imported and crushed in this country—finds its largest outlet as a refined oil for edible use.

In the soap industry, tallow stands out as one of the few materials which was drawn on to a lesser degree than in the preceding year. About four times as much soybean oil went to the soap kettle in 1937 as in 1936 and a three-fold increase was reported for palm-kernel oil. Palm oil also figured in the larger market with a gain for the year in excess of 60 per cent. Whale oil consumption for the period was about double the 1936 total but only a moderate increase was credited to menhaden and other fish oils.

Manufacturers of linoleum and oilcloth continued to rely mainly on linseed oil but there was a notable expansion in the use of castor oil last year which may have resulted from the development of a new type of castor oil with superior drying qualities. China wood oil, probably because of its relatively higher price did not interest these manufacturers in the same degree as in 1936. Perilla oil also failed to hold its 1936 quota with limited supplies in the latter part of the year undoubtedly contributing to this condition.

Imports of vegetable oils last year were on a rising scale with arrivals of China wood oil reaching the record total of 174,884,803 lb. Palm-kernel oil also stands out in the import trade as did palm and soybean oils but a falling off was noted in the case of inedible olive, sunflower, sesame, and perilla oils. A moderate gain in shipments of coconut oil from the Philippines was reported but imports of copra amounted to 537,749,719 lb. compared with 364,493,443 lb. in 1935 which indicates a sharp expansion in domestic coconut oil production.

Factory Consumption of Oils and Fats by Industries
1932–1937
Thousands of Pounds

	Edible Use	Soap	Paint and Varnish	Linoleum and Oilcloth	Printing Ink
1937	2,372,430	1,475,756	457,785	102,763	26,213
1936	2,296,646	1,394,538	441,282	101,882	20,206
1935	2,172,757	1,312,690	404,705	81,031	18,000
1934	1,721,340	1,474,415	329,894	67,811	15,544
1933	1,418,689	1,311,263	297,560	69,938	13,419
1932	1,325,340	1,375,416	254,251	57,515	10,431

Factory Consumption of Primary Animal and Vegetable Fats and Oils, by Classes of Products, Calendar Year, 1937
(Quantities in thousands of pounds)

KIND	Total	Shortening	Oleomargarine	Other Edible Products	Soap	Paint and Varnish	Linoleum and Oilcloth	Printing Inks	Miscellaneous Products	Loss including Foots
Total	4,993,914	1,651,841	324,905	395,684	1,475,756	457,785	102,763	26,213	351,766	207,201
Cottonseed oil	1,716,822	1,209,596	173,615	209,647	8,414	43	....	167	2,632	112,708
Peanut oil	67,515	58,141	2,880	1,937	820	....	....	....	22	3,715
Coconut oil	425,894	12,531	73,806	49,886	252,241	1,124	....	2	6,846	29,458
Corn oil	83,812	1,611	1,796	63,883	2,392	89	....	....	4,005	10,036
Soybean oil	178,516	90,798	31,793	15,530	10,274	16,143	934	80	3,038	9,926
Olive oil, edible	3,296	....	....	3,180	21	....	....	....	95	....
Olive oil, inedible	5,568	....	....	....	890	....	....	....	4,678	....
Sulphur oil or olive foots	18,361	....	....	....	17,984	....	....	....	377	....
Palm-kernel oil	144,041	47	7,946	21,294	111,514	....	....	....	63	3,177
Palm oil	331,054	123,677	1,063	944	141,358	....	....	3	*33,303	30,706
Babassu oil	42,063	127	14,606	11,294	14,308	....	....	....	....	1,728
Rapeseed oil	14,336	5,203	....	....	981	138	....	1	7,493	520
Linseed oil	375,220	1,522	....	....	1,359	267,184	68,151	20,342	16,510	152
China wood oil	120,378	....	....	....	....	105,731	7,198	2,762	4,687	....
Perilla oil	42,537	....	....	....	2	31,776	8,053	1,752	954	....
Castor oil	34,812	....	....	....	2,123	6,455	1,653	260	24,321	....
Sesame oil	37,667	29,269	1	3,435	2,944	....	....	....	81	1,937
Other vegetable oils	25,985	870	....	5,848	10,812	1,498	9	17	6,334	597
Lard	8,938	915	1,747	2,246	....	....	....	3	3,974	53
Edible animal stearin	38,711	29,664	3,375	4,926	321	....	....	....	411	14
Oleo oil	13,055	242	12,277	41	74	....	....	....	402	19
Tallow, edible	68,896	66,278	....	1,593	143	....	....	2	712	168
Tallow, inedible	675,918	....	....	....	613,509	151	....	7	61,921	330
Grease	215,651	....	....	....	94,247	150	....	509	120,421	324
Neat's-foot oil	5,595	....	....	....	16	15	....	1	5,553	10
Marine animal oils	70,196	66	....	....	65,130	11	....	7	4,967	15
Fish oils	229,077	21,284	....	....	123,879	27,277	16,765	298	37,966	1,608

* Includes 30,708 thousand pounds reported by the tin and terne plate industry.